6. Challis Volcanics Section

v. 2015-12-28

Section Description

The Challis Volcanics Section is centrally located in the Middle Rockies–Blue Mountains Ecoregion. The section is named for its extensive and compositionally diverse belt of volcanic rocks derived from an Eocene episode of intense volcanism. The section occurs in the geographic center of the state from the Smoky Mountains in the southwest to the Pioneer Mountains and Big Lost River Valley in the southeast, north through the Salmon River Mountains to the Big Creek drainage in the Frank Church–River of No Return Wilderness (Fig. 6.1, Fig. 6.2).

Railroad Ridge, White Cloud Peaks © YYYY Beth Waterbury

This section contains approximately 35,450 km^2 (13,690 mi^2) and ranges in elevation from 1,200 to 3,600 m (4,000 to 11,800 ft). The section is dominated by no fewer than 6 distinct mountain ranges including the Smoky, Pioneer, Boulder, White Cloud, White Knob, and Salmon River mountains. Climate is generally characterized by a Pacific-influenced moist wintertime regime and dry summer conditions. Climate may be further moderated by a rain shadow effect from the high mountain barrier to the west and by local elevational and other topographic effects of the complex terrain. Precipitation ranges from 25 to 120 cm (10 to 47 in) annually with an average of 56 cm (22 in). About half of precipitation occurs as snow during fall, winter, and spring.

Public lands account for 92% of the section's land base with most under federal management by the US Forest Service (USFS) and Bureau of Land Management (US) (BLM). Federal lands include several specially-designated protected areas comprising Inventoried Roadless Areas, Wilderness Study Areas, Research Natural Areas, Wild and Scenic River segment, the recently designated Jim McClure–Jerry Peak, White Clouds, and Hemingway–Boulders wilderness areas, and portions of the Frank Church–River of No Return Wilderness. These rugged and remote areas are highly sought destinations for hunting, fishing, trapping, horse packing, whitewater rafting, and many other recreational pursuits. In addition to recreation and terrestrial and aquatic habitats, federal lands are also managed for livestock grazing, wood products, and diverse mineral commodities. Private lands are generally concentrated on valley bottoms adjacent to watercourses. The section's population center is the Wood River Valley, including Ketchum,

Hailey, and Bellevue. Development in this scenic valley has been rapid and extensive during recent decades.

Surrounding agricultural lands produce alfalfa, malting barley, seed potatoes, beef cattle, and sheep. Beef cattle and hay/alfalfa forage production are the primary uses on private land in the small, rural community of Challis.

Similar to the sections to its east and west, the Challis Volcanics encompasses vast, relatively intact natural landscapes supporting a diverse array of fish and wildlife. Included are significant core ranges for Wolverine (*Gulo gulo*), Pronghorn (*Antilocapra americana*), Mountain Goat (*Oreamnos americanus*), Bighorn Sheep (*Ovis canadensis*), Elk (*Cervus canadensis*), and Mule Deer (*Odocoileus hemionus*), as well as key spawning habitat for Pacific Lamprey (*Entosphenus tridentatus*), Steelhead (*Oncorhynchus mykiss*), Chinook Salmon (*Oncorhynchus tshawytscha*), and Bull Trout (*Salvelinus confluentus*), and migratory corridor for federally endangered Sockeye Salmon (*Oncorhynchus nerka*). The region's geologic complexity and high relief give rise to extensive and exceptional cliff and rock habitat supporting nesting raptors and numerous bat species.

Surface water features in this section comprise less than 1% of its area. Deep snowpack in the mountains south of the Salmon River feed the Big Wood, Little Wood, West Fork Big Lost, and East Fork Salmon river systems. North of the Salmon River, mountain snowpack feeds into the Yankee Fork Salmon, Middle Fork Salmon, and Big Creek rivers. Hundreds of alpine lakes dot the section's mountainous terrain. The Salmon River system within this section is designated as critical habitat for Snake River Basin Steelhead, Snake River spring/summer-run Chinook Salmon, and Bull Trout. River systems of the Wood River Basin support the endemic Wood River Sculpin (*Cottus leiopomus*) and populations of native Redband Trout (*Oncorhynchus mykiss gairdneri*).

Native shrubland and grassland communities compose an estimated 50% of the section. Collectively, these groups represent important plant and animal species habitats, provide basic natural resource commodities, and constitute important elements of biological diversity. Shrubland types include many taxa of sagebrush with mountain big sagebrush (*Artemisia tridentata* Nutt. subsp. *vaseyana* [Rydb.] Beetle)–bluebunch wheatgrass (*Pseudoroegneria spicata* [Pursh] Á. Löve) and Wyoming big sagebrush (*A. t*. Nutt. subsp. *wyomingensis* Beetle & Young)–Idaho fescue (*Festuca idahoensis* Elmer) associations being most prevalent. Sagebrush-steppe communities provide critical forage resources for Pronghorn, Bighorn Sheep, Elk, and Mule Deer and important habitat for at-risk species such as Greater Sage-Grouse (hereafter Sage-Grouse, *Centrocercus urophasianus*), Long-billed Curlew (*Numenius americanus*), and Pygmy Rabbit (*Brachylagus idahoensis*). A large proportion of sagebrush steppe in this section comprises Greater Sage-Grouse Habitat Management Areas (Fig. 6.3) as developed by the State and federal land management agencies (see Attachment 1, Fig. 2-1; BLM 2015). Deciduous shrublands typically occur on steep canyon slopes below tree line in mosaics with low-elevation grasslands and sagebrush. Characteristic of this community is a high diversity of shrub, forb, and grass species that provide abundant food and cover for numerous birds, mammals, reptiles, amphibians, and invertebrates. This section contains outstanding examples of curl-leaf mountain mahogany (*Cercocarpus ledifolius* Nutt.) scrublands primarily on steep, dry

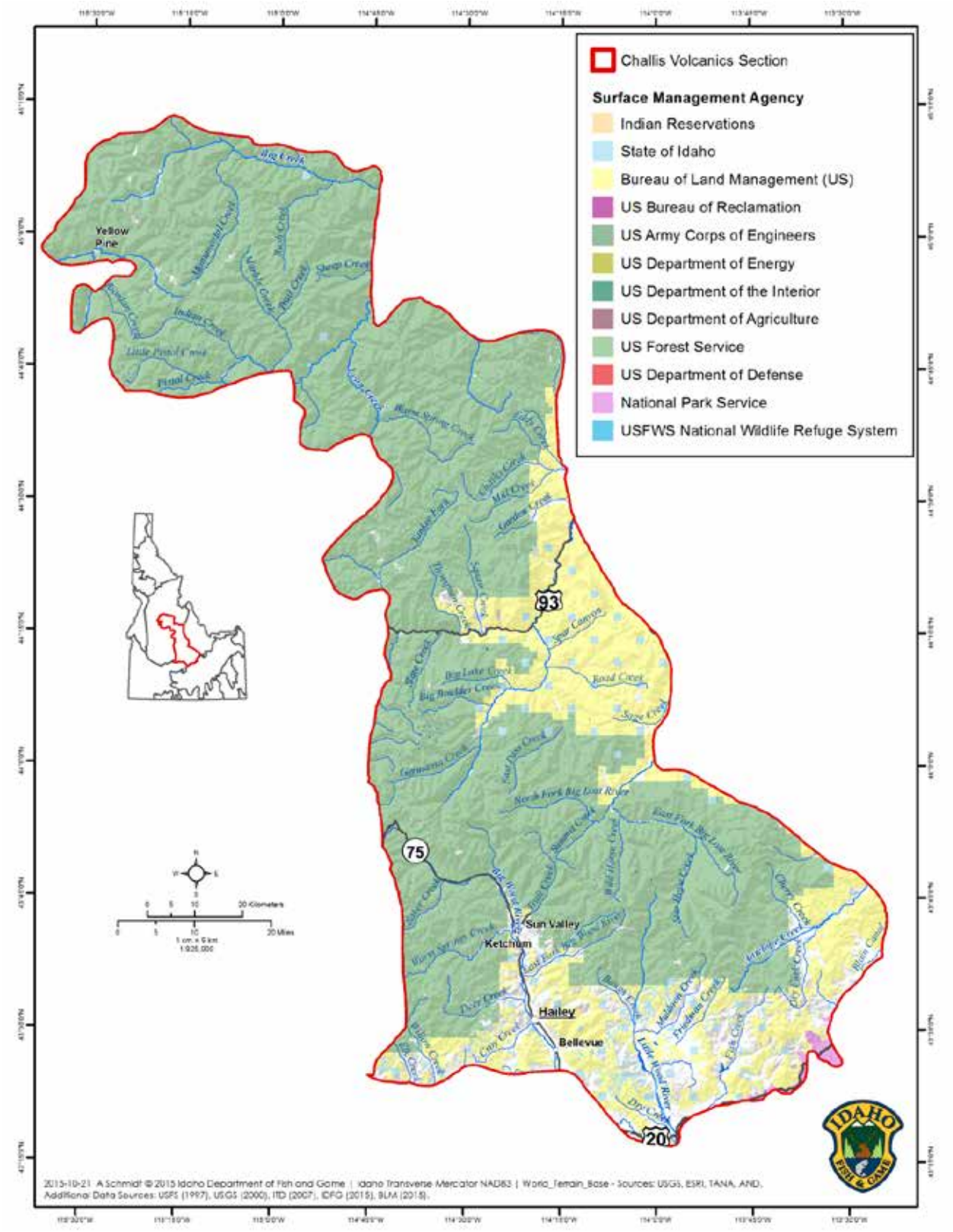


Fig. 6.1 Map of Challis Volcanics surface management

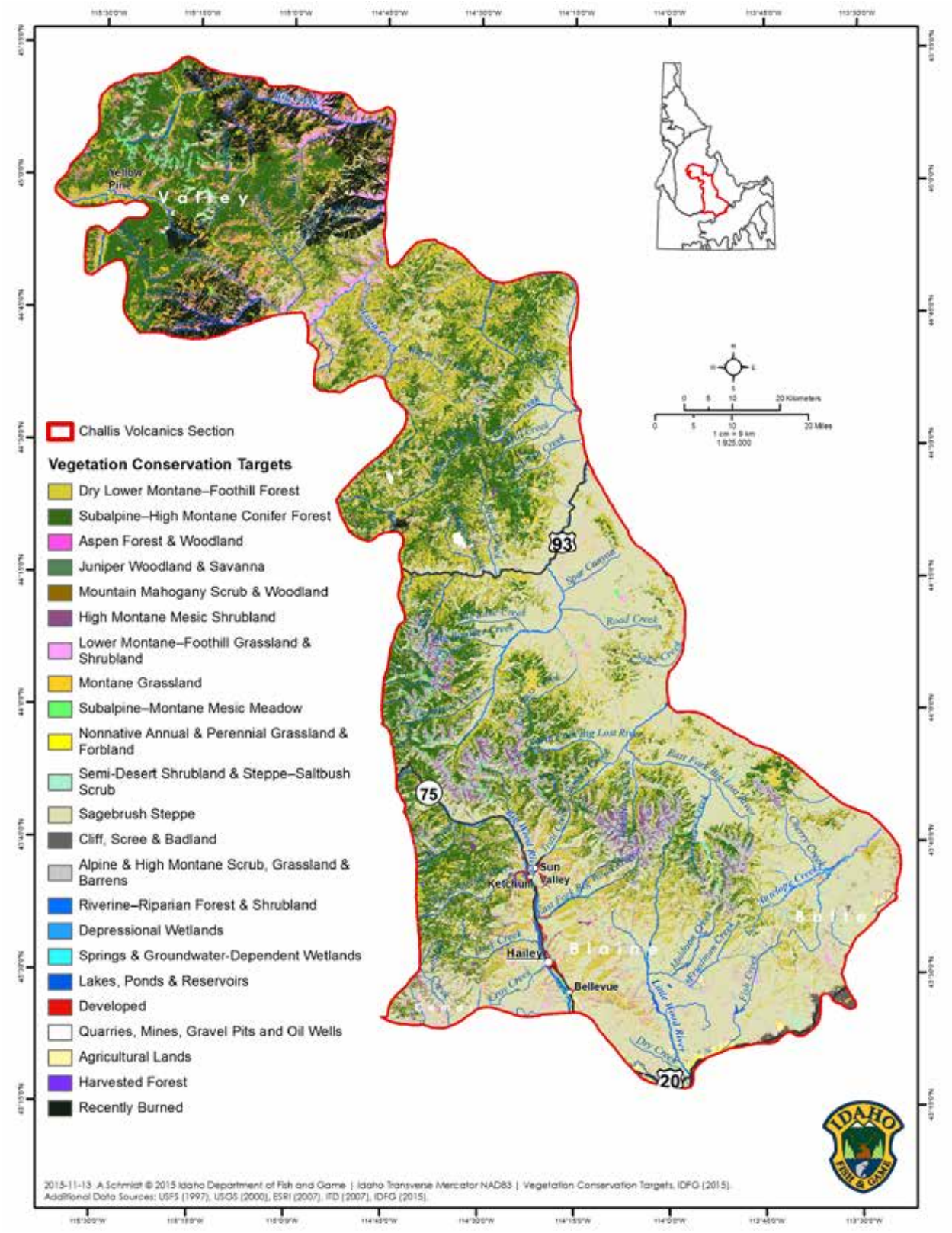


Fig. 6.2 Map of Challis Volcanics vegetation conservation targets

slopes and ridges with warm, southeast through west-facing aspects. These stands are heavily used by wild ungulates, notably as winter range for Mountain Goat, Bighorn Sheep, Moose (*Alces americanus*), and Elk, and as year-round habitat for Mule Deer.

Conifer forests are a dominant vegetation type in this section, comprising about 40% of the land cover. Western Engelmann spruce (*Picea engelmannii* Parry ex Engelm.)–subalpine fir (*Abies lasiocarpa* [Hook.] Nutt.) and whitebark pine (*Pinus albicaulis* Engelm.) forests occur at highest elevations, with lodgepole pine (*Pinus contorta* Douglas ex Loudon) and Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) forests at mid elevations. All forest types have experienced moderate to extensive mortality in recent decades from insect, disease, and fire disturbance. These perturbations contribute to forest patch, pattern, and structural heterogeneity, which in turn enhance biological diversity. Forested communities provide important summer and transitional habitat for Mountain Lion (*Puma concolor*), American Black Bear (*Ursus americanus*), Elk, Mule Deer, and other big game, and food and cover for numerous birds, small mammals, amphibians, and terrestrial invertebrates. Whitebark pine, quaking aspen (*Populus tremuloides* Michx.), cottonwood (*Populus* L.), and Utah juniper (*Juniperus osteosperma* [Torr.]) forest types are more restricted in extent, but comprise unique and ecologically important communities on this landscape. Considered a keystone and foundational species, whitebark pine is a major subalpine component of this section. Quaking aspen tends to occur in small, isolated stands as a seral tree species in aggregate with conifers or along water courses. Cottonwood forests are another broad-leaved deciduous forest type most extensive on the Big Wood, West Fork Big Lost, East Fork Salmon, and mainstem Salmon River systems. Here they are typically confined to narrow streamside bands within floodplains. Utah juniper woodlands occupy rocky foothills at the southernmost ends of the Smoky, Pioneer, and White Knob mountains, typically forming open-canopied savannahs.

The section's multiple mountain ranges with elevations over 3600 m (11,811 ft) contribute to well-developed alpine communities, including community types unique to Idaho (Richardson and Henderson 1999). Alpine areas provide important ecological services by capturing snow and storing runoff to sustain the section's primary watersheds and downstream uses. Although faunal diversity is low compared to other habitats, alpine species are typically specialized to exploit the harsh environment. Characteristic species include Black Rosy-Finch (*Leucosticte atrata*), American Pika (*Ochotona princeps*), Wolverine, Mountain Goat, and Hoary Marmot (*Marmota caligata*). Alpine areas are largely in public ownership and protected as wilderness, thus, human impacts have been relatively low compared to other ecosystems.

Conservation Targets in the Challis Volcanics

We selected 9 habitat targets (6 upland, 3 aquatic) that represent the major ecosystems in the Challis Volcanics as shown in Table 6.1. Each of these systems provides habitat for key Species of Greatest Conservation Need (SGCN), i.e., "nested targets" (Table 6.2) associated with each target. All SGCN management programs in the Challis Volcanics have a nexus with habitat management programs. We provide a high-level summary of current viability status for each target. Conservation of the habitat targets listed below should conserve most of the nested species within them. However, we determined that at least 2 taxa (Wolverine, Bighorn Sheep)

and 2 assemblages (Bats, Pollinators) face special conservation needs and thus are presented as explicit species targets as shown in Table 6.1.

Table 6.1 At-a-glance table of conservation targets in the Challis Volcanics

Target	Target description	Target viability	Nested targets (SGCN)	
Dry Lower Montane–Foothill Forest	Forms 15% of section's land base at mid-elevations. Douglas-fir and lodgepole pine types are dominant with ponderosa pine component at the north end. Utah juniper woodlands occur on rocky foothills at the far south end. Quaking aspen and mountain mahogany may be intermixed.	*Fair*. Fire suppression has created conditions highly susceptible to insect outbreaks and high intensity stand-replacing fires. Lack of disturbance has also suppressed vigor of understory vegetation and allowed extensive areas of Douglas-fir to encroach on grassland and sagebrush steppe habitats.	*Tier 1* *Tier 2* *Tier 3*	Wolverine Western Toad Ferruginous Hawk Golden Eagle Lewis's Woodpecker Silver-haired Bat Hoary Bat Fisher Bighorn Sheep Great Gray Owl Common Nighthawk Olive-sided Flycatcher Clark's Nutcracker Black Rosy-Finch Townsend's Big-eared Bat Western Small-footed Myotis Little Brown Myotis Spur-throated Grasshopper Group
Subalpine–High Montane Conifer Forest	Comprises 24% of section's land base. Generally forms the highest-elevation forests including the upper tree line ecotone with alpine habitat. This section contains important populations of whitebark pine, a keystone and foundation species of this target.	*Fair*. Altered fire regimes are favoring succession of fire-intolerant trees more susceptible to high-severity fires. The threat posed by white pine blister rust, in synergy with mountain pine beetle, altered fire regimes, and climate change, threatens the viability of whitebark pine communities and the ecosystem services they provide.	*Tier 1* *Tier 2* *Tier 3*	Wolverine Western Toad Golden Eagle Silver-haired Bat Hoary Bat Fisher Great Gray Owl Olive-sided Flycatcher Clark's Nutcracker Black Rosy-Finch Little Brown Myotis Mountain Goat
Aspen Forest & Woodland	Aspen is an uncommon (<2% of land base) yet important habitat in this section. Although small in extent, aspen communities harbor high biodiversity, maintain water storage capacity for watersheds, and offer recreation	*Poor*. Aspen decline across the western US is attributed to altered fire regimes and heavy ungulate grazing leading to poor regeneration. Recurring drought as a result of climate change could exacerbate	*Tier 2* *Tier 3*	Western Toad Lewis's Woodpecker Silver-haired Bat Hoary Bat Fisher Great Gray Owl Common Nighthawk Olive-sided Flycatcher Townsend's Big-eared Bat Western Small-footed Myotis Little Brown Myotis

Target	Target description	Target viability	Nested targets (SGCN)	
	and scenic value to humans.	aspen decline.		
Lower Montane–Foothill Grassland & Shrubland	Comprising 3% of the section's land base, this target includes a subset of grasslands, shrub steppe, and deciduous shrubland types found below the lower tree line and extending up into high montane zones. This is a compositionally diverse habitat supporting numerous SGCN.	*Fair*. Altered fire regimes have resulted in dry conifer encroachment and dense shrublands outside the range of natural historic variation. Livestock grazing use has altered species composition. Invasive weeds have pioneered on many road and trail systems.	*Tier 1* *Tier 2* *Tier 3*	Greater Sage-Grouse Ferruginous Hawk Golden Eagle Long-billed Curlew Burrowing Owl Bighorn Sheep Short-eared Owl Common Nighthawk Black Rosy-Finch Townsend's Big-eared Bat Western Small-footed Myotis Monarch Spur-throated Grasshopper Group
Sagebrush Steppe	This system covers 53% of the section's land base and is characterized by an open shrub canopy and sparse to dense herbaceous layer dominated by perennial grasses. Microbiotic crusts are typically present. Sagebrush steppe habitats are relatively intact compared to more fragmented landscapes in other sections.	*Good*. Target is extensive, strongly continuous, and exhibits a diversity of age classes and structure. Most is in public ownership, thus, less vulnerable to rangewide threats of habitat fragmentation and conversion to agriculture common in areas of mixed ownership. Target is relatively resilient to the fire/cheatgrass cycle in this section.	*Tier 1* *Tier 2* *Tier 3*	Greater Sage-Grouse Ferruginous Hawk Golden Eagle Long-billed Curlew Burrowing Owl Sage Thrasher Sagebrush Sparrow Pygmy Rabbit Bighorn Sheep Sandhill Crane Short-eared Owl Common Nighthawk Townsend's Big-eared Bat Western Small-footed Myotis Spur-throated Grasshopper Group
Alpine & High Montane Scrub, Grassland & Barrens	Target contains a relatively large area of alpine land cover (2%) relative to other sections in Idaho. System is concentrated in the newly designated Wilderness Areas of the Boulder and White Cloud mountains. Target supports wildlife species specialized for cold, snowy environments.	*Good*. Most of this system is protected as Wilderness Area. Other areas are "de facto" wilderness due to remoteness and inhospitable conditions for human habitation. Alpine wildlife is sensitive to climatic factors and may have low adaptive capacity to climate change.	*Tier 1* *Tier 2* *Tier 3*	Wolverine Golden Eagle Bighorn Sheep Clark's Nutcracker Black-Rosy Finch Western Small-footed Myotis Mountain Goat Hoary Marmot A Grasshopper (*Argiacris keithi*) A Grasshopper (*Argiacris militaris*) Spur-throated Grasshopper Group
Riverine–Riparian Forest &	This system includes rivers and streams,	*Fair to Good*. System accounts	*Tier 1*	Pacific Lamprey Steelhead (Snake River Basin

Target	Target description	Target viability	Nested targets (SGCN)	
Shrubland	including aquatic habitats and their associated terrestrial riparian habitats. Major river systems are the Big Wood, Little Wood, West Fork Big Lost, East Fork Salmon, Yankee Fork Salmon, Middle Fork Salmon, and Big Creek.	for <1% of land area, but supports diverse array of aquatic and terrestrial biota, including keystone species (salmon, American Beaver, cottonwood) and migration, juvenile rearing, spawning, or resident habitat for 5 ESA-listed fish species. Water diversions have resulted in perturbation of fluvial processes and riparian conditions in this section.		DPS) Sockeye Salmon (Snake River ESU) Chinook Salmon (Snake River spring/summer-run)
			Tier 2	Western Toad Harlequin Duck Lewis's Woodpecker Silver-haired Bat Hoary Bat Fisher Bighorn Sheep Western Pearlshell A Mayfly (*Ephemerella alleni*)
			Tier 3	Sandhill Crane Common Nighthawk Townsend's Big-eared Bat Western Small-footed Myotis Little Brown Myotis Western Ridged Mussel A Mayfly (*Parameletus columbiae*) Monarch Tiny Forestfly A Caddisfly (*Eocosmoecus schmidi*) A Caddisfly (*Limnephilus challisa*) A Caddisfly (*Psychoglypha smithi*) A Caddislfy (*Sericostriata surdickae*)
Springs & Groundwater-Dependent Wetlands	This target includes seeps, springs, and wet meadows occurring on gentle to steep slopes from floodplain to montane forest elevations. These are rare mesic features in a semiarid landscape, thus attract a diversity of wildlife and invertebrate species.	*Poor*. These systems are highly attractive to livestock and wildlife as sources of palatable green forage and water. Improper livestock grazing and OHV impacts can cause soil compaction and erosion, destroy vegetation, facilitate spread of invasive weeds, and alter hydrologic processes.	*Tier 1*	Greater Sage-Grouse
			Tier 2	Western Toad Ferruginous Hawk Golden Eagle Long-billed Curlew Bobolink Silver-haired Bat Hoary Bat Bighorn Sheep
			Tier 3	Sandhill Crane Great Gray Owl Short-eared Owl Common Nighthawk Townsend's Big-eared Bat Western Small-footed Myotis Little Brown Myotis Monarch
Lakes, Ponds, & Reservoirs	Target comprises all natural lakes and deep ponds, created water bodies of all sizes, and dammed river channels. Includes	*Good*. Large lakes/reservoirs established for irrigation water storage benefit fish and wildlife. High mountain lake fish-	*Tier 2*	Western Toad Long-billed Curlew Silver-haired Bat Hoary Bat
			Tier 3	Sandhill Crane Common Nighthawk Western Small-footed Myotis

Target	Target description	Target viability	Nested targets (SGCN)	
	Jimmy Smith Lake, Herd Lake, and Mosquito Flats, Little Wood, and Fish Creek reservoirs. Includes hundreds of high mountain lakes in upper montane, subalpine, and alpine elevations.	stocking programs should continue to balance recreational opportunity and maintenance of native amphibian populations. Climate change may impair lake temperatures and productivity.		Little Brown Myotis Monarch
Wolverine	The Wolverine population in this section is part of the Salmon–Selway core population occupying the central Idaho mountains complex. Most primary habitat is within designated Wilderness Areas.	*Fair*. Climate warming and shrinking snow cover may amplify the fragmented nature of Wolverine habitat at the southern end of this section resulting in diminished connectivity and a subpopulation more vulnerable to extirpation.	*Tier 1*	Wolverine
Bighorn Sheep	Bighorn Sheep are distributed within 4 contiguous Population Management Units: Middle Fork Salmon River, Middle Main Salmon River, East Fork Salmon River, and Pioneers (see IDFG Bighorn Sheep Management Plan 2010).	*Good*. Some PMUs stable in terms of population size and structure.	*Tier 2*	Bighorn Sheep
Bat Assemblage	The Challis Volcanic's vast, natural landscape provides a diversity of suitable habitats for bats, but knowledge of bat distribution, abundance, and habitat associations is incomplete and fragmentary.	*Presumed Good.* Surveys and monitoring are needed to locate hibernacula, assess local levels of disturbance or destruction of roosting habitats, identify seasonal movement patterns and migration corridors, and assess risks associated with white-nose syndrome.	*Tier 2* *Tier 3*	Silver-haired Bat Hoary Bat Townsend's Big-eared Bat Western Small-footed Myotis Little Brown Myotis
Pollinators	There is insufficient	*Good*. Presumably	*Tier 1*	Morrison Bumble Bee

Target	Target description	Target viability	Nested targets (SGCN)	
	data on SGCN pollinator species in this section.	based on large spatial extent and good condition of native plant communities in surrounding public lands.	*Tier 3*	Western Bumble Bee Suckley Cuckoo Bumble Bee Hunt's Bumble Bee A Mason Bee (*Hoplitis producta*) Monarch

Table 6.2 Species of Greatest Conservation Need (SGCN) and associated conservation targets in the Challis Volcanics

Taxon	Conservation targets												
	Dry Lower Montane–Foothill Forest	Subalpine–High Montane Conifer Forest	Aspen Forest & Woodland	Lower Montane–Foothill Grassland & Shrubland	Sagebrush Steppe	Alpine & High Montane Scrub, Grassland & Barrens	Riverine–Riparian Forest & Shrubland	Springs & Groundwater-Dependent Wetlands	Lakes, Ponds, & Reservoirs	Wolverine	Bighorn Sheep	Bat Assemblage	Pollinators
FISH													
Pacific Lamprey[1]							X						
Steelhead (Snake River Basin DPS)[1]							X						
Sockeye Salmon (Snake River ESU)[1]							X						
Chinook Salmon (Snake River spring/summer-run ESU)[1]							X						
AMPHIBIANS													
Western Toad[2]	X	X	X				X	X	X				
BIRDS													
Harlequin Duck2		X					X						
Greater Sage-Grouse[1]				X	X			X					
Ferruginous Hawk[2]	X			X	X			X					
Golden Eagle[2]	X	X		X	X	X		X					
Sandhill Crane[3]							X	X	X				
Long-billed Curlew[2]				X	X			X					
Burrowing Owl[2]				X	X								
Great Gray Owl[3]	X	X	X					X					
Short-eared Owl[3]				X	X			X					
Common Nighthawk[3]	X		X	X	X		X	X	X				
Lewis's Woodpecker[2]	X		X				X						
Olive-sided Flycatcher[3]	X	X	X										
Clark's Nutcracker[3]	X	X				X							
Sage Thrasher[2]					X								
Sagebrush Sparrow[2]					X								
Bobolink[2]								X					
Black-Rosy Finch[3]	X	X				X							
MAMMALS													
Pygmy Rabbit[2]					X								
Townsend's Big-eared Bat[3]	X		X	X	X		X	X				X	
Silver-haired Bat[2]	X	X	X				X	X	X			X	
Hoary Bat[2]	X	X	X				X	X	X			X	
Western Small-footed Myotis[3]	X		X	X	X	X	X	X	X			X	

Taxon	Conservation targets												
	Dry Lower Montane–Foothill Forest	Subalpine–High Montane Conifer Forest	Aspen Forest & Woodland	Lower Montane–Foothill Grassland & Shrubland	Sagebrush Steppe	Alpine & High Montane Scrub, Grassland & Barrens	Riverine–Riparian Forest & Shrubland	Springs & Groundwater-Dependent Wetlands	Lakes, Ponds, & Reservoirs	Wolverine	Bighorn Sheep	Bat Assemblage	Pollinators
Little Brown Myotis[3]	X	X	X				X	X	X			X	
Wolverine[1]	X	X				X				X			
Fisher[2]	X	X	X				X						
Mountain Goat[3]		X				X							
Bighorn Sheep[2]	X			X	X	X	X	X			X		
Hoary Marmot[3]						X							
ARACHNIDS													
A Cave Obligate Harvestman (*Speleomaster pecki*)[2]													
A Cave Obligate Mite[2] (*Flabellorhagidia pecki*)													
AQUATIC BIVALVES													
Western Pearlshell[2]							X						
Western Ridged Mussel[3]							X						
INSECTS													
A Mayfly (*Ephemerella alleni*)[2]							X						
A Mayfly (*Parameletus columbiae*)[3]							X						
A Miner Bee (*Andrena aculeata*)[3]													X
Hunt's Bumble Bee[3]													X
Morrison Bumble Bee[1]													X
Western Bumble Bee[1]													X
Suckley Cuckoo Bumble Bee[1]													X
Monarch3				X			X	X	X				X
A Grasshopper (*Argiacris keithi*)[3]						X							
A Grasshopper (*Argiacris militaris*)[3]						X							
Spur-throated Grasshopper Group[3]	X			X	X	X							
Tiny Forestfly[3]							X						
A Caddisfly (*Eocosmoecus schmidi*)[3]							X						
A Caddisfly (*Limnephilus challisa*)[3]							X						
A Caddisfly (*Psychoglypha smithi*)[3]							X						
A Caddislfy (*Sericostriata surdickae*)[3]							X						

Target: Dry Lower Montane–Foothill Forest

Dry Lower Montane–Foothill Forest communities comprise about 15% of this section. They typically occur at the lower tree line ecotone immediately above valley grasslands or sagebrush steppe and shrublands. Douglas-fir is the predominant forest type, but lodgepole pine (*Pinus contorta* Douglas ex Loudon) and limber pine (*Pinus flexilis* James) forests may intermix. ponderosa pine (*Pinus ponderosa* Lawson & C. Lawson) is a codominant canopy tree at the northern end of the section, and Utah juniper (*Juniperus osteosperma* [Torr.]) woodlands are found on rocky foothills at the southern end of the section. Quaking aspen (*Populus tremuloides* Michx.) and curl-leaf mountain mahogany (*Cercocarpus ledifolius* Nutt.) can also be intermixed. Fire suppression has interrupted the natural fire regime in this habitat type, resulting in unnaturally high tree densities with greater competition, less vigor, and growth; susceptibility to insect outbreaks; and high risk of stand-replacing fires. Absence of fire has also suppressed vigor of understory vegetation and allowed extensive areas of Douglas-fir to encroach on grassland and sagebrush-steppe habitats. Most of this community type occurs on public lands managed by USFS and BLM.

Fish Creek, Pioneer Mountains © 2010 Brenda Erhardt

This ecosystem supports several SGCN including Ferruginous Hawk (*Buteo regalis*), Olive-sided Flycatcher (*Contopus cooperi*), Clark's Nutcracker (*Nucifraga columbiana*), Black Rosy-Finch, Wolverine, and Bighorn Sheep. Lewis's Woodpecker (*Melanerpes lewis*) is present where ponderosa pine is a dominant component, and Western Toad (*Anaxyrus boreas*) occurs in kettle holes within lodgepole pine forests. This system provides abundant snag and live-tree structure for bat roosting and insect prey for bat foraging.

Target Viability

Fair. Nearly a century of fire suppression in most of this forest type has created conditions highly susceptible to insect outbreaks and high intensity stand-replacing fires. Absence of fire disturbance also results in Douglas-fir encroachment of quaking aspen forests, ecotonal grasslands, and sagebrush-steppe communities. Noxious weeds such as spotted knapweed (*Centaurea stoebe* L.) have colonized many roads in this forest type, particularly at lower-elevation sites.

Prioritized Threats and Strategies for Dry Lower Montane–Foothill Forest

High Rated Threats to Dry Lower Montane–Foothill Forest in the Challis Volcanics

Altered fire regimes

These forest types evolved under the influence of frequent, low-severity fire that maintained relatively open stands of a mix of fire resistant species. Nearly a century of fire suppression has dramatically shifted successional patterns, reduced spatial heterogeneity of forest types, increased the density of small shade-tolerant trees, and produced an unnatural accumulation of ground fuels. These conditions, further exacerbated by drought and warmer temperatures, have led to massive insect outbreaks and tree mortality. As a result, many low- and mid-elevation conifer forests in this section are susceptible to uncharacteristically large, high-intensity, stand-replacing fires. The continuing absence of fire in the dry montane forest type has allowed extensive areas of Douglas-fir to encroach into montane and foothill grasslands, sagebrush-steppe habitats, and aspen forests. Absence of fire has also altered diversity, habitat structure, and productivity of understory shrubs, forbs, and grasses.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Restore characteristic fire regime and forest structure in dry lower montane forest systems.	Coordinate actions with federal land management agencies and municipalities.	Engage and involve forest collaboratives in the development and implementation of forest restoration projects. Incorporate prescribed fire treatments in restoration projects. Use managed natural fire for forest restoration where/when appropriate. Incorporate mechanical thinning treatments to reduce stand densities where appropriate. Develop landscape-level models that evaluate commodity production, fire risk, forest health, and habitat needs of fish and wildlife in an integrated fashion.	Western Toad Ferruginous Hawk Golden Eagle Great Gray Owl Common Nighthawk Lewis's Woodpecker Olive-sided Flycatcher SGCN bats Fisher Bighorn Sheep SGCN bees Spur-throated Grasshopper Group Pollinators
Where appropriate, develop more aggressive strategies to reduce fuel load.	Improve targeting of fuels reduction opportunities and implementation.	Evaluate opportunities for harvesting and removal of biomass to meet treatment objectives and supply local biofuel facilities. Forest vegetation management includes evaluation opportunities for harvesting and removal of biomass to meet treatment objectives. Use stewardship contracts to achieve public land management goals in rural communities.	Western Toad Ferruginous Hawk Golden Eagle Great Gray Owl Common Nighthawk Lewis's Woodpecker Olive-sided Flycatcher SGCN bats Fisher Bighorn Sheep SGCN bees

Objective	Strategy	Recommended Action(s)	Target SGCNs
			Spur-throated Grasshopper Group Pollinators
Change societal perceptions to accept fire as a beneficial tool for forest stewardship.	Develop effective stakeholder outreach on the role of wildland fire in forest health.	Engage forest collaboratives to promote benefits of forest restoration techniques, including use of fire. Develop and disseminate public outreach products on fire ecology in dry forest systems (news releases, presentations, brochures, articles).	Western Toad Ferruginous Hawk Golden Eagle Great Gray Owl Common Nighthawk Lewis's Woodpecker Olive-sided Flycatcher SGCN bats Fisher Bighorn Sheep SGCN bees Spur-throated Grasshopper Group
Minimize conflicts between fire suppression and forest health policies.	Develop growth management policies in Wildland-Urban Interface areas.	Develop local land use ordinances to minimize rural/urban sprawl into wildlands. Incorporate climate change and fire behavior information into growth management and rural interface community planning initiatives.	Western Toad Ferruginous Hawk Golden Eagle Great Gray Owl Common Nighthawk Lewis's Woodpecker Olive-sided Flycatcher SGCN bats Fisher Bighorn Sheep SGCN bees Spur-throated Grasshopper Group Pollinators

Forest Insect pests and disease

Dry forest types in the Smoky, Pioneer, and Salmon River mountain ranges have experienced extensive tree mortality in the last decade associated with widespread outbreaks of Mountain Pine Beetle (*Dendroctonus ponderosae*) and Western Spruce Budworm Moth (*Choristoneura occidentalis*). Outbreaks often develop in dense stands of mature age-class lodgepole pine, mid-sized ponderosa pine, and homogeneous Douglas-fir forests. Warming climatic conditions and continued fire suppression have intensified insect outbreaks in this region. Extensive tree mortality associated with insect and disease outbreaks can significantly influence successional pathways and forest community composition. Other short- and long-term forest processes such as water yield and wildfire extent and severity can also be affected by tree mortality associated with insect outbreaks.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Reduce the potential for large-scale loss of dry lower montane forest stands to insect outbreaks.	Implement restorative forest management at the landscape level.	Identify and strategically place forest restoration treatments in landscape locations and orientations for maximum benefit. Conduct risk assessments and appropriately prioritize areas for treatment. Restore appropriate stocking levels, species composition, and stand structure to levels more consistent with conditions under which host trees and insect/pathogen species coevolved.	Western Toad Ferruginous Hawk Golden Eagle Great Gray Owl Common Nighthawk Lewis's Woodpecker Olive-sided Flycatcher SGCN bats Fisher Bighorn Sheep SGCN bees Spur-throated Grasshopper Group Pollinators

Changing temperature and precipitation regimes

Current climate models predict changing precipitation patterns and warming temperatures for the Challis Volcanics Section. Precipitation and temperature changes may be of great enough magnitude to exceed the environmental tolerances of existing plant species and their related fauna and ecosystem services from portions of the this section. Change in precipitation from snow to rain is much more likely to induce earlier summer plant dormancy, lengthen the fire season, and shorten the wetland saturation period (van Mantgem et al. 2009). Predicted temperature increases for central Idaho show at least a 6-fold increase of area burned by wildfire (relative to the median annual area burned during 1950–2003) with each 1 °C (1.8 °F) of temperature increase (Littell et al. 2009). The goal of dry forest restoration should be to develop more open structure consistent with historical disturbance regimes (Arno et al. 1995, Stephens et al. 2012). This goal creates forests more resilient to and compatible with a warmer and dryer future.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase resiliency of dry lower montane forest types to climate pattern uncertainty.	Actively implement restorative forest management at the landscape level.	Employ silvicultural and prescribed fire treatments to restore characteristic forest stand structure, fuel loading, and vegetative heterogeneity. Incorporate climate change mitigation strategies in forest and resource management plans.	Western Toad Ferruginous Hawk Golden Eagle Great Gray Owl Common Nighthawk Lewis's Woodpecker Olive-sided Flycatcher SGCN bats Fisher Bighorn Sheep SGCN bees Spur-throated Grasshopper

Objective	Strategy	Recommended Action(s)	Target SGCNs
			Group Pollinators

Noxious weeds and invasive annual grasses

The invasion of nonnative grasses and forbs is now a threat to dry lower montane–foothill forests. These invasive weeds were historically considered a low-elevation problem; however, they are now spreading to higher elevations and spreading rapidly in some mid-elevation areas. Noxious weeds (e.g., spotted knapweed) and invasive annual grasses (e.g., cheatgrass) have colonized some habitat types of this section at lower and mid-elevations. Noxious weeds and invasive annual grasses replace native forbs and grasses, reduce forage quality for herbivorous wildlife, and increase the risk of intensified fire regimes. The predicted warming trends for this region may generate the biophysical conditions favored for further cheatgrass establishment.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Control or eradicate noxious weeds.	Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence.	Participate in County Cooperative Weed Management Area collaboratives. Map and identify noxious weed patches and provide to the appropriate land manager. Use biological controls (insects) on infestations of spotted knapweed. Conduct aggressive weed management as part of post-fire habitat restoration. Monitor roads and trails leading into key wildlife habitats for presence of weeds and treat aggressively if detected. Provide native grass and shrub seed recommendations to land managers.	Western Toad, Ferruginous Hawk, Golden Eagle, Great Gray Owl, Common Nighthawk, Lewis's Woodpecker, Olive-sided Flycatcher, SGCN bats, Fisher, Bighorn Sheep, SGCN bees, Spur-throated Grasshopper Group, Pollinators

Improper livestock grazing management

Improper grazing tends to increase shrub cover and reduce the understory of more palatable herbaceous vegetation. Mesic drainage bottoms tend to attract and hold livestock during the hottest part of the summer, which causes overbrowsing and trampling of sensitive riparian areas within dry lower montane–foothill forests. Persistent grazing can reduce native perennials, increase bare ground, and intensify the expansion of noxious weeds and annual grasses (Johnson and Swanson 2005). SGCN species particularly sensitive to improper grazing in the dry lower montane–foothill forest include ground-nesting birds (e.g., Common Nighthawk) where removal of herbaceous vegetation reduces nest concealment, thereby increasing exposure to predation or nest parasitism. Challenges persist in the realm of insufficient funds for federal land-management agency oversight and insufficient monitoring of allotments to assess forest rangeland health and evaluate trends in rangeland condition, as well as grazing permit compliance.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Support proper livestock grazing management that maintains rangeland health and habitat quality.	Consider livestock grazing in a site-specific context over time where vegetative condition can be manipulated by the timing, intensity, duration, and frequency of grazing practices.	Prioritize permit renewals and land health assessments for allotments with declining Sage-Grouse populations (Otter 2012). Conduct fine-scale habitat assessments to inform grazing management. Consider resting (placing in nonuse status) a unit for a period to achieve identified resource objective(s). Build in support for an option of "grass reserve units." Seek and apply the best possible tools and techniques to influence the distribution of livestock. Consider the distribution of, and access to, stock water in springs, seeps, wet meadows, potholes across the uplands late in the summer relative to perennial stream access. Support adequate funding and personnel to collect and analyze livestock grazing-related monitoring and rangeland health data. Undertake adaptive management changes related to existing grazing permits when improper grazing is determined to be the causal factor in not meeting habitat objectives (Otter 2012).	Western Toad, Ferruginous Hawk, Golden Eagle, Lewis's Woodpecker, Fisher, Bighorn Sheep, Pollinators

Target: Subalpine–High Montane Conifer Forest

Subalpine–high montane conifer forest communities comprise a substantial portion of this section (approximately 24%) and generally form the elevationally uppermost forests, including the upper-tree line ecotone with the alpine. Characteristic trees are subalpine fir, Engelmann spruce, whitebark pine, lodgepole pine, limber pine, and quaking aspen, which form variable canopies from nearly closed to open or patchy with intervening grasslands and shrublands. Subalpine fir and Engelmann spruce form climax or long-lived seral forests in this section, with periodic disturbance from windthrow, avalanches, and more prominently, insect outbreaks and stand-replacing fire. Lodgepole pine forest types occur in cold-air drainages as seral even-aged stands. Whitebark pine and limber pine are prevalent forest types in upper subalpine environments where they are important foundation and keystone species. The threat posed by the introduced pathogen that causes white pine blister rust, in synergy with mountain pine beetle, altered fire regimes, and predicted warming trends, threatens the sustainability of these fragile 5-needled pine communities.

Subalpine forests and woodlands in this section are almost exclusively managed by the US Forest Service and form expansive, continuous, and largely unroaded habitat strongholds for a wide range of wildlife. Characteristic species include Wolverine, Mountain Goat, Bighorn Sheep, Clark's Nutcracker, and Black Rosy-Finch. Boggy sites within subalpine forests also harbor Western Toad, and decay-prone spruce and fir trees provide roosting and natal sites for bats. A variety of native ungulate species use this habitat type for summer range where mixed openings and delayed plant phenology produce favorable forage.

Spruce Gulch Lake, Salmon River Mountains © 2015 IDFG

Target Viability

Fair. The Challis Volcanics contains a substantial holding of the keystone species whitebark pine. Whitebark pine has decreased from its historical extent due to synergistic actions of white pine blister rust and mountain pine beetle. Reduction of this keystone species may have implications on habitat quality, intensity of snowpack melt, and species composition at high elevations. Nearly a century of fire suppression in this forest type has created conditions susceptible to insect outbreaks, high intensity stand-replacing fires, and Douglas-fir encroachment of aspen forests, ecotonal grasslands, and sagebrush steppe communities.

Prioritized Threats and Strategies for Subalpine–High Montane Conifer Forest

High Rated Threats to Subalpine–High Montane Conifer Forest in the Challis Volcanics

Changing temperature and precipitation regimes

Current climate models predict changing precipitation patterns and warming temperatures for the Challis Volcanics Section. Precipitation and temperature changes may be of great enough magnitude to exceed the environmental tolerances of existing plant species and their related fauna and ecosystem services from portions of this section. Change in precipitation from snow to rain is much more likely to induce earlier summer plant dormancy, lengthen the fire season, and shorten the wetland saturation period (van Mantgem et al. 2009). Predicted temperature increases for central Idaho show at least a 6-fold increase of area burned by wildfire (relative to the median annual area burned during 1950–2003) with each 1 °C (1.8 °F) of temperature

increase (Littell et al. 2009). This trajectory suggests that without active forest management, subalpine–high montane conifer forest systems will become less resilient and less compatible with a warmer and dryer future.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase resiliency of subalpine–high montane conifer forest types to climate pattern uncertainty.	Actively implement restorative forest management at the landscape level.	Develop landscape-level models that evaluate commodity production, fire risk, forest health, and habitat needs of fish and wildlife in an integrated fashion. Identify and prioritize areas for immediate restoration treatments. Incorporate prescribed fire treatments in restoration projects. Use managed natural fire for forest restoration where/when appropriate. Incorporate mechanical thinning treatments to reduce stand densities and crown cover where appropriate. Favor retention of fire-tolerant tree species and restore fine-scale patchiness. Retain older age-class or large trees as part of a managed stand to create structural and age-class heterogeneity. Engage and involve forest collaboratives in the development and implementation of forest restoration projects.	Western Toad, Golden Eagle, Great Gray Owl, Olive-sided Flycatcher, Clark's Nutcracker, Black Rosy-Finch, Silver-haired Bat, Hoary Bat, Little Brown Myotis, Wolverine, Fisher, Mountain Goat, Pollinators

Insects and disease in 5-needled pines

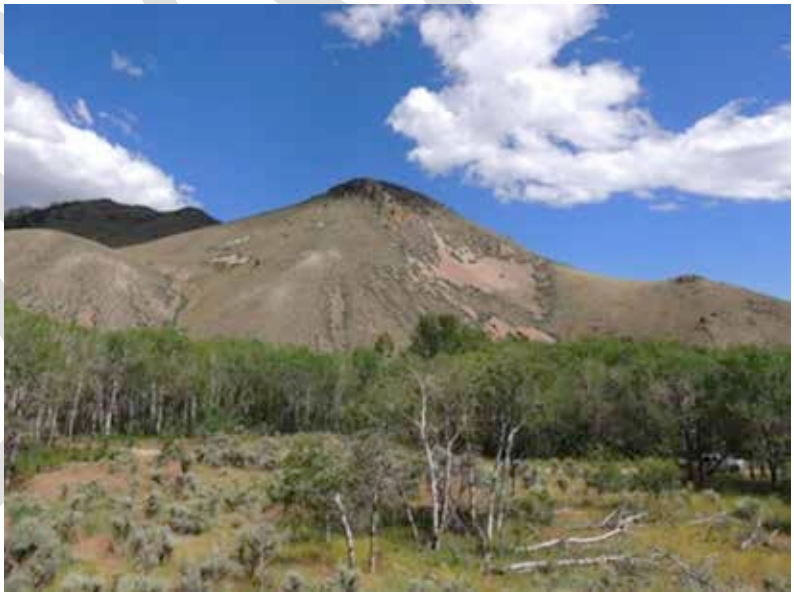
Whitebark pine and limber pine are native 5-needled pines considered foundation species of high-elevation settings of this section. These woodland types serve a variety of key ecological roles, including providing food resources for Clark's Nutcracker, squirrels, and other birds and improving snow retention. Populations of whitebark and limber pines in this section have been extensively and severely impacted by epidemics of mountain pine beetle and white pine blister rust. Current forecasts for warming climate change suggest continued optimal conditions for pine beetle outbreaks for many decades (Hicke and Logan 2009). The introduced pathogen that causes white pine blister rust poses a more insidious threat given it affects all aspects of the 5-needled pine forest regeneration process and will impair ecosystem recovery long after pine beetle epidemics phase out. Continued losses of whitebark and limber pines in this section could adversely modify hydrological processes critical to listed anadromous fish and other aquatic-associated species in the Challis Volcanics Section.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Ensure future persistence and viability of whitebark pine.	Support and implement long-term strategies to restore whitebark pine (i.e., A Range-Wide Restoration	Collect whitebark pine seed for genetic testing, gene conservation, rust screening, and operational planting. Cultivate rust-resistant whitebark pine seedlings to out-plant to disturbed areas.	Clark's Nutcracker, Black Rosy-Finch, Wolverine, Mountain Goat, Pollinators

Objective	Strategy	Recommended Action(s)	Target SGCNs
	Strategy for Whitebark Pine (*Pinus albicaulis*) (Keane et al. 2012).	Allow wildfire to treat potentially declining areas to reduce competing subalpine fir and create caching habitat for Clark's Nutcrackers. Preserve putative rust-resistant cone-bearing trees as cultivated and natural seed sources. Plant burned areas with rust-resistant whitebark pine seedlings. Use stand-level treatments to restore high value or critical declining stands, especially those stands that are distant from seed sources, that contain putative rust-resistant cone-bearing trees, or that are too valuable to lose from uncontrolled wildfire (e.g., Clark's Nutcracker habitat). Inventory, monitor, evaluate, and adaptively manage treatment sites.	

Target: Aspen Forest & Woodland

Aspen is an important yet uncommon (<1% of landbase) vegetation community in most of the Challis Volcanics Section. Aspen is somewhat more abundant in the upper Big Wood River Valley, the upper East Fork of the Salmon, and the higher elevations of the Salmon River Mountains because of higher precipitation. Although small in scale, healthy aspen communities harbor high biodiversity and are critically important to Mule Deer, Elk, birds, bats, amphibians, and pollinator insects. In addition, they maintain water storage capacity for watersheds and offer recreation and scenic value to humans. Aspen stands in this section are typically small (<4 ha [10 acres]) and interspersed with conifers or part of a riparian area. Although aspen is naturally seral in this section, it has declined about 60% since European settlement (Bartos 2001). This decline has been due primarily to changes in fire regimes and heavy ungulate browsing leading to poor regeneration. Within this section, aspen is found in lower elevation dry forest, montane riparian areas, subalpine forest, subalpine meadows and shrublands, and mountain big sagebrush stands.



Garden Creek, Salmon River Mountains © 2015 Beth Waterbury

Recent fire activity in the Big Creek and Middle Fork Salmon River vicinities, Ketchum area, White Cloud Mountains, and Salmon River Mountains west of Challis have certainly benefited aspen stands by removing encroaching conifers and encouraging aspen suckering. In addition, land managers and their partners have made significant progress in the last decade to inventory aspen stands and assess their condition and likelihood for successful treatment. Notable efforts include restoration of aspen stands in the Pioneer Mountains and Salmon River Mountains west of Challis on the Salmon–Challis National Forest, and projects implemented by Lava Lake Land and Livestock in the Fish Creek, Copper Creek, and Little Wood drainages.

Target Viability

Aspen condition is poor over most of the section, primarily from conifer encroachment and heavy ungulate browsing. Climate change resulting in less precipitation, higher temperatures, and recurring drought could exacerbate aspen decline. The rapid rate of development in the Big Wood River Valley may be reducing aspen abundance. Recent fire activity is probably benefiting stands that were previously declining from conifer encroachment and lack of disturbance. In addition, forest restoration projects taking place around the section are resulting in improved aspen stand conditions.

Prioritized Threats and Strategies for Aspen Forest & Woodland

High rated threats to Aspen Forest & Woodland in the Challis Volcanics

Changing precipitation and temperature patterns

Long range climate models predict hotter and drier conditions for the Challis Volcanics Section. A bioclimate model developed for aspen in the Central Rockies predicts a 40–75% decline in the extent of aspen range by the decade surrounding 2060 (Rehfeldt et al. 2009). In fact, the effects of drought and warmer temperatures have already become evident in the form of Sudden Aspen Decline (SAD) documented over the last decade in parts of the Central Rockies (Morelli and Carr 2011). Within this section, it is difficult to determine if this phenomenon has occurred, as many of these stands are small and already stressed from conifer encroachment and extensive ungulate browsing.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase resiliency of aspen stands to altered precipitation and temperature regimes.	Implement actions aimed at increasing the health and vigor of existing stands.	Identify all stands with high levels of conifer encroachment and implement conifer removal. Use prescribed burning to stimulate suckering and stand expansion. Thin conifers upslope from aspen stands to increase water availability. Erect barriers such as fencing and stacking of felled conifers to protect treated stands from livestock and wild ungulate damage. Use expertise of collaborative aspen working groups to achieve objective.	Western Toad, Common Nighthawk, Lewis's Woodpecker, Olive-Sided Flycatcher, Townsend's Big-eared Bat, Silver-haired Bat, Hoary Bat, Western Small-footed Myotis, Little Brown Myotis, Fisher,

Objective	Strategy	Recommended Action(s)	Target SGCNs
			Pollinators

Improper livestock grazing management

Regeneration and recruitment of aspen stands has been hindered by improper livestock grazing in this section. Many poor condition stands are in mesic drainage bottoms (e.g., Salmon River Mountains, East Fork Salmon drainage, Pioneer Mountains) that attract and hold livestock during the hottest part of the summer. Long-term grazing retards aspen recruitment at a level that can affect overall stand age-structure and its long-term presence on the landscape (Beschta et al. 2014). Although detrimental browsing pressure by native ungulates may occur, especially where winter densities are high (Smith et al. 2001), these animals are widespread over their range and impacts to aspen recruitment are often not measurable (DeByle 1985).

Objective	Strategy	Recommended Action(s)	Target SGCNs
Promote and ensure compliance of proper livestock grazing management.	Work with and encourage land managers to improve livestock grazing management where damage is occurring.	Identify aspen stands where recruitment is impaired by livestock browsing or physical damage. Work with federal agency range specialists and allotment permittees to modify grazing practices to reduce impacts on aspen regeneration. Deploy remote cameras in heavily browsed aspen stands to determine level of wild ungulate use. Use expertise of collaborative aspen working groups to achieve objective.	Western Toad, Common Nighthawk, Lewis's Woodpecker, Olive-Sided Flycatcher, Townsend's Big-eared Bat, Silver-haired Bat, Hoary Bat, Western Small-footed Myotis, Little Brown Myotis, Fisher, Pollinators

Altered fire regimes

Natural fire intervals have been altered throughout the Challis Volcanics Section. Recent, significant fires have occurred west of Ketchum, on the west flank of the White Cloud Mountains, in the Salmon River Mountains north of Stanley and west of Challis, and in the Big Creek and Middle Fork Salmon drainages. With the exception of the latter 2 areas, all fires have been vigorously suppressed because of human safety and property concerns. Some natural starts in higher elevations have been allowed to burn within predefined perimeters. Fire suppression, which allows competing conifers to suppress aspen regeneration, has been identified as the primary driver behind the decline of aspen in the West (Kulakowski et al. 2013).

Objective	Strategy	Recommended Action(s)	Target SGCNs
Promote restoration of natural fire regimes.	Increase use of prescribed fire and mechanical treatments to mimic natural fire history.	Identify and map conifer encroachment within aspen stands where regeneration is compromised. Provide technical assistance and encouragement to land managers for aspen improvement projects.	Western Toad, Common Nighthawk, Lewis's Woodpecker, Olive-Sided Flycatcher,

Objective	Strategy	Recommended Action(s)	Target SGCNs
		Assist with post-treatment monitoring. Engage with and participate in the Central Idaho Aspen Working Group to achieve aspen restoration objectives.	Townsend's Big-eared Bat, Silver-haired Bat, Hoary Bat, Western Small-footed Myotis, Little Brown Myotis, Fisher, Pollinators

Target: Lower Montane–Foothill Grassland & Shrubland

This target comprises approximately 3% of the section's land area and includes a subset of grasslands, shrub steppe, and deciduous shrubland types found below the lower tree line and extending up into high montane zones. Grasslands are prevalent on warmer, drier sites, especially at higher elevation. Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) are predominant grasses but a variety of cool-season graminoids may be present. Shrublands often occur on cooler, more mesic sites, including the steep slopes of canyons, north aspects, and toeslopes. Common shrubs include Saskatoon serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), rose (*Rosa* spp.), blue elderberry (*Sambucus nigra* ssp. *cerulea*), common snowberry (*Symphoricarpos albus*), and oceanspray (*Holodiscus discolor*). Forb diversity is typically high in both mesic and dry aspects of this community.

Several SGCN are associated with this compositionally diverse habitat. Bighorn Sheep use the grasslands to graze on preferred grasses and forbs, but may seasonally shift to subsist on shrubs. Grassland and shrubland habitats provide nesting, brood-rearing, and foraging sites for Greater Sage-Grouse, Short-eared Owl, Burrowing Owl, and Long-billed Curlew. The wide variety of grasses, forbs, and shrubs in this habitat type provide abundant nectar and pollen resources for a diverse assemblage of pollinator species.

Blue Mountain, Salmon River Mountains © 2015 Windy Davis

Target Viability

Fair. Lower montane–foothill grassland & shrubland communities generally occur at lower elevations at the interface of private lands. Consequently, they have a long history of human use, both for commodity purposes (e.g., livestock grazing), and as an area where effective fire exclusion was practiced early on and eventually altered the historic disturbance regime. Changes in fire intensity and frequency have resulted in Douglas-fir invasion in many areas, or the development of dense shrublands outside the range of natural historic variation. In some areas, improper livestock grazing has altered plant species composition, soil compaction, nutrient levels, and vegetative structure. Invasive weeds have pioneered many roads and trails in this system, affecting the structure and composition of this target.

Prioritized Threats and Strategies for Lower Montane–Foothill Grassland & Shrubland

High Rated Threats to Lower Montane–Foothill Grassland & Shrubland in the Challis Volcanics

Improper livestock grazing management

Livestock grazing is the most widespread economic land use in this system and a legacy activity that has modified much of this vegetative community from its historical condition. Livestock grazing can have a keystone effect on these habitats where livestock occur at economically meaningful densities (Bock et al. 1993). For example, livestock grazing can change grassland habitat features that directly influence birds by reducing ground-nesting cover, substrate for an abundance and diversity of insect prey, and herbaceous cover and foliage height diversity for mammalian prey. The trampling action of livestock can degrade biological soil crusts, which are essential features of arid steppe plant communities that reduce soil evaporation, aid in nitrogen fixation of plants, and inhibit the establishment of invasive nonnative species such as cheatgrass

and spotted knapweed (Belnap et al. 2001). Nonnative weed species not only outcompete native bunchgrasses, but are also susceptible to larger and more frequent fires.

Several grassland-associated SGCN respond negatively to improper livestock grazing that alters native habitat features, most notable being the Greater Sage-Grouse. Whereas the proximate effect of livestock grazing on these SGCN may be the removal of grass and forbs important as forage and cover, the ultimate effect may be perpetuation of weedy annuals that outcompete native plants these SGCN are uniquely adapted to.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Support proper livestock grazing management that maintains rangeland health and habitat quality (Otter 2012).	Consider livestock grazing in a site-specific context over time where vegetative condition can be manipulated by the timing, intensity, duration, and frequency of grazing practices (Otter2012).	Prioritize permit renewals and land health assessments for allotments with declining Sage-Grouse populations (Otter 2012). Conduct fine-scale habitat assessments to inform grazing management. Consider resting (placing in nonuse status) a unit for a period to achieve identified resource objective(s). Build in support for an option of "grass reserve units." Seek and apply the best possible tools and techniques to influence the distribution of livestock. Consider the distribution of, and access to, stock water in springs, seeps, wet meadows, potholes across the uplands late in the summer relative to perennial stream access. Support adequate funding and personnel to collect and analyze livestock grazing–related monitoring and rangeland health data. Undertake adaptive management changes related to existing grazing permits when improper grazing is determined to be the causal factor in not meeting habitat objectives (Otter 2012).	Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, Common Nighthawk, Bighorn Sheep, Pollinators

Altered fire regime

Fire is a naturally occurring but highly variable natural disturbance in this system. Although fire has historically played a part in its composition and distribution, the system is not always fire-driven. Although fire suppression has abetted the encroachment of Douglas-fir into some grasslands and shrublands, many sites in this section are too xeric to support tree growth, even in the absence of fire. Likewise, fire suppression has allowed the development of shrub communities dominated by old, dense, and decadent shrubs with substantial amounts of fuels. Consequently, fires that do occur are likely to be high severity, and system recovery slow.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Restore characteristic fire	Coordinate actions with	Identify and map key areas in need of restoration treatments.	Greater Sage-Grouse,

Objective	Strategy	Recommended Action(s)	Target SGCNs
regimes in lower montane–foothill grassland and shrubland systems.	federal land management agencies, livestock permittees, municipalities, and other stakeholders.	Implement targeted restoration techniques including prescribed burning, seeding, mechanical treatment, and/or changes in livestock grazing regimes. Work with livestock grazing permittees and private landowners to implement fuels treatment actions on their lands and allotments as part of strategic, landscape efforts (DOI 2015). Implement aggressive and targeted application of both proven techniques and the rapid investigation and implementation of new practices to control cheatgrass and spotted knapweed, and mitigate habitat impacts from unwanted rangeland fire (DOI 2015).	Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, Common Nighthawk, Bighorn Sheep, Pollinators
Reduce conifer encroachment in lower montane–foothill grassland systems.	Targeted removal of Douglas-fir or Utah juniper to remove young-age class trees expanding into grassland and shrubland communities.	Mechanical treatment of Douglas-fir/Utah juniper in key areas including lop and lay, mastication, and lop and scatter methods. Exclude old-growth Douglas-fir or Utah juniper stands from any vegetation treatments. Use categorical exclusions to conduct treatments on public lands.	Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, Common Nighthawk, Bighorn Sheep, Pollinators

Noxious weeds and invasive annual grasses

The invasion of nonnative grasses and forbs is a threat within this target habitat type. Noxious weeds (e.g., spotted knapweed) and annual grasses (e.g., cheatgrass) have colonized some areas of native grasslands and shrublands. Site disturbances such as intensive fire or improper livestock grazing that reduces native plant vigor or creates conditions optimal for noxious weed establishment (e.g., destruction of soil crusts due to trampling) has led to the establishment of invasive, nonnative species in this habitat type; this problem is exacerbated in areas of lower precipitation where nonnative cheatgrass is able to outcompete native grasses by using early spring moisture while native grasses remain dormant. These low-quality noxious weeds are replacing more nutritious forbs and grasses, lowering forage quality and increasing the risk of intensified fire regimes. The predicted warming trends for this region may generate the biophysical conditions favored for cheatgrass establishment.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Control or eradicate noxious weeds.	Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence.	Participate in County Cooperative Weed Management Area collaboratives. Map and identify noxious weed patches and provide to the appropriate land manager. Use biological controls (insects) on infestations of spotted knapweed.	Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, Common

Objective	Strategy	Recommended Action(s)	Target SGCNs
		Conduct aggressive weed management as part of post-fire habitat restoration. Monitor roads and trails leading into key wildlife habitats for presence of weeds and treat aggressively if detected. Provide native grass and shrub seed recommendations to land managers.	Nighthawk, Townsend's Big-eared Bat, Western Small-footed Myotis, Bighorn Sheep, Monarch, Spur-throated Grasshopper Group

Target: Sagebrush Steppe

Sagebrush-steppe habitats dominate the landscape of the Challis Volcanics Section, forming approximately 53% of its land base. These arid habitat types are prevalent across the intermontane basins and foothills located in the rain shadow of the central Idaho mountains. Plant communities are characterized by an open shrub canopy and sparse to dense herbaceous layer dominated by perennial graminoid associates and typically have a microbiotic crust of lichens and mosses binding the upper surface of the soil. Sagebrush-steppe habitats in this section are relatively intact compared to the highly fragmented landscapes in other regions of Idaho. This is attributed to the high proportion of sagebrush-steppe habitats in public ownership, primarily under BLM management. These habitats are largely continuous and extensive, supporting connectivity for species at multiple spatial scales. This section encompasses extensive and continuous tracts of Greater Sage-Grouse Habitat Management Areas (Fig. 6.3). This section also includes the Challis Wild Horse and Burro Herd Management Area (HMA). Though the HMA appropriate management level is set at 185 horses, the population estimate has ranged in recent years to as high as 366. Although relatively pristine climax sagebrush steppe communities occur in this section, most sites have been modified to some degree by a legacy of past livestock grazing, which has rendered disturbed stands less ecologically complex than the mosaic that they replaced (Daubenmire 1966).

Spar Canyon Pygmy Rabbit habitat © 2010 Beth Waterbury

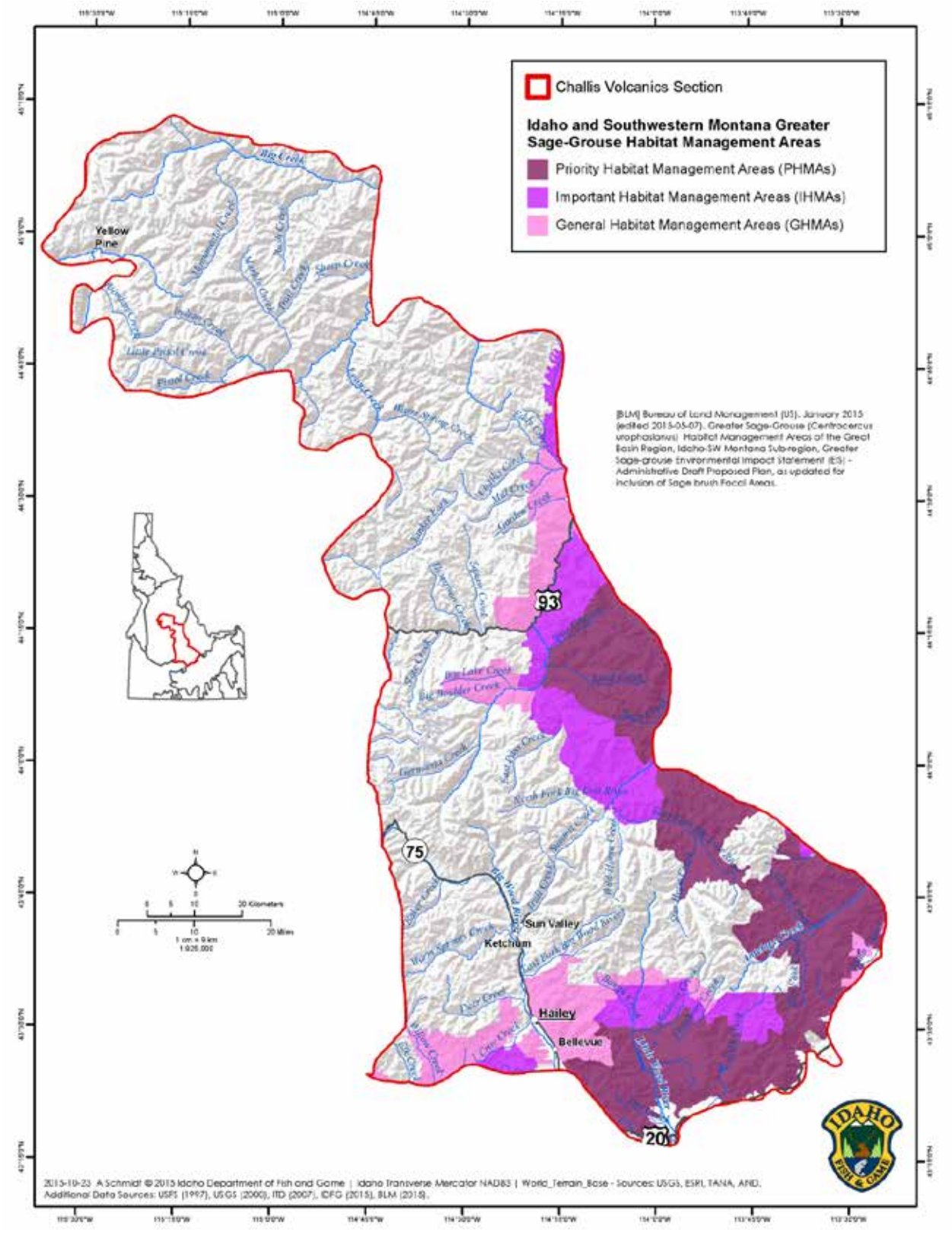


Fig. 6.3 Greater Sage-Grouse Habitat Management Areas in the Challis Volcanics Section

Within the greater expanse of sagebrush steppe are frequent inclusions of semi–desert shrubland & steppe–saltbush scrub that form continuous shrub-steppe habitat. These pockets are concentrated on arid alluvial soils of Bradbury Flat, Antelope Flat, Little Antelope Flat, Spar Canyon, and Malm Gulch at lowest elevations. Stands are usually dominated by a mix of several shrubs or dwarf shrubs, but total vegetation cover is low (<30%). Dominant shrubs may include fourwing saltbush (*Atriplex canescens*), shadscale saltbush (*Atriplex confertifolia*), bud sagebrush (*Picrothamnus desertorum*), spiny hopsage (*Grayia spinosa*), and winterfat (*Krascheninnikovia lanata*). The herbaceous layer is often sparse and dominated by perennial grasses, especially Indian ricegrass (*Achnatherum hymenoides*) and sand dropseed (*Sporobolus cryptandrus*). The forb layer can be diverse, but forms sparse cover. These unique inclusions, which primarily occur on private and BLM land, are valuable in providing structural and compositional diversity to the sagebrush steppe landscape.

This section's heterogeneous mix of semiarid, mesic, and montane sagebrush steppe groups influences the ecology of associated birds, mammals, reptiles, amphibians, and invertebrates. The low vertical structural diversity of these habitats provides fewer habitat layers for wildlife, resulting in lower diversity in some taxa. But what this habitat may lack in variety, it makes up for in specificity. Characteristic sagebrush obligates of this section are Greater Sage-Grouse, Sage Thrasher, Sagebrush Sparrow, and Pygmy Rabbit. Sagebrush steppe types also support a suite of grassland-associated birds including Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Burrowing Owl, Short-eared Owl, Common Nighthawk, and Grasshopper Sparrow. Grass-dominated sagebrush steppe provides important foraging areas preferred by Bighorn Sheep and Elk.

Target Viability

Sagebrush steppe communities in this section are in good condition, extensive, strongly continuous, and exhibit a diversity of age classes and structure. Exceptions are found in the relatively flat, front-range areas where past livestock and wild horse grazing has contributed to depauperate herbaceous understories with intact sagebrush overstories. Most sagebrush-steppe habitat in this section is in public ownership, and is therefore less vulnerable to rangewide threats of habitat fragmentation and conversion to agriculture prevalent in areas of mixed ownership. This system is relatively resilient to the fire–cheatgrass cycle affecting many areas in Idaho's Snake River Plain, but may become less so under future climate warming scenarios predicted for this region. Pockets of semi-desert shrubland & steppe–saltbush scrub within the sagebrush steppe target appear less viable. These sites are typically the hottest, driest, and lowest elevation sites in the section and, therefore, have low site potential compared to cool, mesic sagebrush sites (Maestas et al. 2014). Such sites are more sensitive to impacts from improper livestock grazing or invasive weed species due to low potential resilience and resistance.

Prioritized Threats and Strategies for Sagebrush Steppe

High Rated Threats to Sagebrush Steppe in the Challis Volcanics

Improper livestock grazing management

Sagebrush steppe ecosystems in this section did not evolve with large ungulate herds, and their grasses were poorly adapted for introductions of domestic cattle, sheep and horses.

Consequently, legacy livestock grazing practices have impacted the composition, structure, and productivity of this system in some locations. These impacts included loss of the microbiotic layer, loss of native grasses, reduction in herbaceous biomass, increase of shrub cover, and facilitated invasions of exotic grasses and forbs. Past range management practices have involved the use of prescribed fire, herbicides, and plowing/mowing to remove dense sagebrush canopies and reestablish grass forage through reseeding of crested wheatgrass (*Agropyron cristatum*), a nonnative perennial bunchgrass.

Present-day grazing by domestic livestock and wild horses continues to influence species composition and structure of sagebrush-steppe communities by increasing shrub cover and reducing the understory of more palatable herbaceous vegetation. The colonization of dry conifer woodlands into sagebrush habitats has generally been ascribed to some combination of fire exclusion, livestock grazing (both directly and through its influence on fire), and climate. Livestock grazing in semi-desert shrubland & steppe–saltbush scrub communities requires sensitive application due to low grazing capacities, slow rates of recovery for existing deteriorated areas, and potential damage to soils and microbiotic crusts. These sites are best suited for livestock use during dormant periods, as plants can withstand much less grazing pressure and have higher mortality rates if grazed during growth periods (West and Gasto 1978). These communities are highly susceptible to invasion by halogeton (*Halogeton glomeratus*), Russian thistle (*Kali tragus*), and cheatgrass (*Bromus tectorum*) and are difficult and slow to restore.

SGCN species particularly sensitive to improper grazing include ground-nesting birds such as Greater Sage-Grouse, Long-billed Curlew, Burrowing Owl, Short-eared Owl, Common Nighthawk, Sagebrush Sparrow, and Grasshopper Sparrow, where removal of herbaceous vegetation reduces nest concealment, thereby increasing exposure to predation, weather, or nest parasitism. Areas with grazing-induced dense sagebrush cover are often avoided by foraging Ferruginous Hawks (Howard and Wolfe 1976). Cattle have been reported to have little deleterious effect on Bighorn Sheep and Elk if they do not graze on critical winter ranges (Tesky 1993).

A noteworthy long-term trend on public land has been replacement of season-long cattle grazing with various rotational grazing systems designed to maintain or improve rangeland health. However, challenges persist in the realm of insufficient funds for federal land management agency oversight and insufficient monitoring of allotments to assess rangeland health and evaluate trends in rangeland condition, as well as grazing permit compliance.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Support proper livestock grazing management that maintains rangeland health and habitat quality.	Manage the timing, intensity, duration, and frequency of grazing practices to manipulate vegetative condition (Otter 2012).	Prioritize permit renewals and land health assessments for allotments with declining Sage-Grouse populations (Otter 2012). Designate allotments and schedule grazing periods based on factors such as elevation, weather, and plant growth (e.g., limit duration of hot season use). Consider winter grazing regimes in areas with substantial inclusions of semi-desert shrubland &	Greater Sage-Grouse and other sagebrush-steppe dependent species

Objective	Strategy	Recommended Action(s)	Target SGCNs
		steppe-saltbush scrub habitat. Conduct fine-scale habitat assessments to inform grazing management. Consider resting (placing in nonuse status) a unit for a period to achieve identified resource objective(s). Build in support for an option of "grass reserve units." Seek and apply the best possible tools and techniques to influence the distribution of livestock. Consider the distribution of, and access to, stock water in springs, seeps, wet meadows, potholes across the uplands late in the summer relative to perennial stream access. Support adequate funding and personnel to collect and analyze livestock grazing-related monitoring and rangeland health data. Undertake adaptive management changes related to existing grazing permits when improper grazing is determined to be the causal factor in not meeting habitat objectives (Otter 2012). Continue to monitor and manage Wild Horses in the Challis Herd Management Area to maintain populations at the appropriate management level of 185 individuals.	
	Implement the livestock grazing management framework outlined in the Governor's Alternative (see Otter 2012).	Inform affected permittees and landowners regarding Sage-Grouse habitat needs and conservation measures (Idaho Sage-grouse Advisory Committee 2006). Incorporate GRSG Seasonal Habitat Objectives (Table 2-2 in BLM 2015) into relevant resource management plans and projects. Prioritize permit renewals and land health assessments for allotments with declining Sage-Grouse populations (Otter 2012). Conduct fine-scale habitat assessments to inform grazing management. Undertake adaptive management changes related to existing grazing permits when improper grazing is determined to be the causal factor in not meeting habitat objectives (Otter 2012).	Greater Sage-Grouse and other sagebrush-steppe dependent species
Further understand potential	Assess the impacts (negative and	Implement new, properly designed, and replicated experiments involving a variety of alternative grazing treatments (including no	Greater Sage-Grouse and other

Objective	Strategy	Recommended Action(s)	Target SGCNs
impacts to sagebrush-associated biota from livestock grazing.	positive) of livestock grazing on sagebrush-steppe obligate passerines.	grazing at all) across the spectrum of major shrub-steppe habitat types (Rotenberry 1998). Conduct experiments over multiple years (Rotenberry 1998).	sagebrush-steppe dependent species
Support the continued responsible use of federal lands for grazing to maintain open spaces and important habitat conditions that benefit wildlife.	Implement Western Governors' Association (WGA) policy for public lands grazing (for details, see WGA Policy Resolution 2015-03).	Use sound, science-based management decisions for federal lands and base these decisions upon flexible policies that take into account local ecological conditions and state planning decisions.	Greater Sage-Grouse and other sagebrush-steppe dependent species

Transportation and service corridors

Infrastructure such as roads, highways, high-voltage transmission lines, and cell phone towers (Governor's Executive Order No. 2015-04; Otter 2015) is identified as a primary threat (Otter 2012) and causes fragmentation and direct loss of shrub-steppe habitats (US Fish and Wildlife Service 2014). The most visible and well-documented impact of roads is direct mortality of wildlife through wildlife-vehicle collisions. Indirect effects on wildlife include habitat loss and fragmentation, increased human disturbance or access, facilitated spread of invasives, and increased risk of predation. Studies suggest populations of sagebrush steppe obligate and dependent wildlife species are particularly sensitive to these impacts (Braun 1998, Connelly et al. 2004). In the Challis Volcanics Section, major paved roads intersecting sagebrush steppe habitats include State Highways 20, 26, and 75. These roads constitute a major anthropogenic footprint within the Challis, East Magic Valley, and Upper Snake Sage-Grouse Planning Areas (SGPA). Both Challis and Upper Snake are among SGPAs with the greatest total major road mileage in Idaho (Idaho Sage-grouse Advisory Committee 2006). These SGPAs constitute 2 of 8 SGPAs in Idaho with >50% of their area potentially influenced by major roads, based on a 10 km (6.2 mi) buffer outward from each side of these roads to account for an influence from predation and noise disturbance (Connelly et al. 2004). Numerous secondary road systems (e.g., paved, county, primitive) also potentially influence sagebrush steppe habitat and associated wildlife through factors such as increased human access, OHV use, spread of invasive species, increased risk of wildfire, and increased mortality from collisions. Major transmission lines also occur in this section, primarily located in highway right-of-ways. Tall structures such as transmission towers in sagebrush steppe ecosystems provide ravens and raptors with elevated substrate for perching and nesting where trees are rare or nonexistent. These structures are thought to concentrate ravens and raptors along utility corridors, which may increase the risk of predation to Greater Sage-Grouse, Pygmy Rabbit, and other sagebrush-dependent wildlife.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Reduce impacts of roads and utility lines to sagebrush steppe-	Coordinate the development and siting of roads and utility lines with relevant	Avoid siting and construction of new power lines and associated features in "designated" habitat (see Avian Power Line Interaction Committee [APLIC]. 2015 Best Management Practices for Electric Utilities in Sage-Grouse	Greater Sage-Grouse and other sagebrush-steppe

Objective	Strategy	Recommended Action(s)	Target SGCNs
associated wildlife.	agencies and industry.	Habitat). Follow management actions outlined in the Governor's Executive Order No. 2015-04 (Otter 2015) as it pertains to PHMA (Core), IHMA, and GHMA when proposing to develop transportation and service corridors. Work with key agencies and stakeholders to ensure that roads, transmission lines and other linear infrastructure avoid sensitive habitat areas.	dependent species
	Minimize disturbance to Sage-Grouse and sagebrush-associated wildlife from unrestricted cross-country travel.	Prioritize the completion of Comprehensive Transportation Management Travel Plans (CTMTPs) (Otter 2012). Locate areas and trails to minimize disturbance to Sage-Grouse and other species sensitive to OHV disturbance; use route upgrade, closure of existing routes, timing restrictions, seasonal closures, and creation of new routes to help protect habitat and reduce the potential for pioneering new unauthorized routes (BLM 2015). Conduct road upgrades and maintenance outside the Sage-Grouse breeding season to avoid disturbance on leks (BLM 2015).	Greater Sage-Grouse and other sagebrush-steppe dependent species
	Increase visibility of utility lines in key Sage-Grouse movement corridors.	Identify and map areas where key Sage-Grouse movement corridors and utility lines overlap. In identified high-risk areas, mark utility lines with bird flight markers or other suitable device to reduce Sage-Grouse collisions.	Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Sandhill Crane, Long-billed Curlew, Short-eared Owl

Fences

Due to a long history of livestock production, fences are ubiquitous throughout the sagebrush-steppe habitats of this section. Sagebrush steppe wildlife is adapted to landscapes with few vertical features or obstructions. Consequently for wildlife inhabiting sagebrush steppe, fences can reduce habitat suitability through habitat fragmentation, obstruction of movement corridors (e.g., woven-wire fencing), and injury or mortality from fence collision. Avian SGCN potentially vulnerable to fence collisions and entanglement include Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Burrowing Owl, and Short-eared Owl (Fitzner 1975). Fences pose particular collision hazards to Greater Sage-Grouse when located <2 km from known leks, where fence segments lack wooden fence posts, and where fence segments exceed 4 m (13.1 ft) (Stevens et al. 2012). Fence marking may reduce risk of fence collision by Greater Sage-Grouse by as much as 83% (Stevens et al. 2012). Wooden fence posts may facilitate predation of Greater Sage-Grouse by eagles, hawks, and ravens. Although fences pose some potential threat to sagebrush-steppe habitat, it is important to recognize their utility in grazing management programs designed to achieve proper grazing management.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Reduce the impacts of fences on Sage-Grouse and other sagebrush-associated wildlife.	Work with landowners and land management agencies to identify fences (including new fences) that may pose risk for collision mortality.	Work with local utilities, landowners, and land management agencies to identify and mark problem fences. Apply wildlife-friendly fencing standards when constructing or modifying fences (e.g., Paige 2012). Identify and remove unnecessary fences or other structures (Otter 2012, [BLM] Bureau of Land Management (US) 2015). When placing new fences or other structural range improvements (such as corrals, loading facilities, water tanks, and windmills), consider their impact on Sage-Grouse (Otter 2012). Place new, taller structures (e.g., corrals, loading facilities, water storage tanks, windmills) at least 1 km from occupied leks (Otter 2012) and within existing disturbance corridors or in unsuitable habitat (BLM 2015).	Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Sandhill Crane, Long-billed Curlew, Burrowing Owl, Short-eared Owl

Noxious weeds and invasive annual grasses

The invasion of nonnative grasses and forbs is a major threat to sagebrush-steppe habitats and in some areas takes precedence over all other ecological concerns. Invasive species are recognized as the primary extinction risk factor for Greater Sage-Grouse across its range (USDI-Fish and Wildlife Service 2005) and are identified as a primary threat to Sage-Grouse in Idaho by the Governor's Alternative (Otter 2012). The Challis Volcanics Section lies within the Mountain Valley Sage-Grouse Conservation Area, which is considered at lower risk to invasive species than other areas of the state. The Challis and Upper Snake Sage-Grouse Working Groups of this section identified invasive plant species as high risk factors within their respective Planning Areas, citing adverse impacts from displacement of desirable species, altered fire frequencies, reduced value of sagebrush steppe habitat (Challis Sage-Grouse Local Working Group 2007, Upper Snake Sage-Grouse Local Working Group 2009). Noxious weeds (e.g., spotted knapweed and skeletonweed) and invasive annuals (e.g., cheatgrass) and perennials (e.g., Kentucky bluegrass) have colonized and become naturalized in some of the sagebrush habitat types of this section at lower and mid-elevations. Though the cheatgrass/fire cycle is not as pervasive an issue in this section as the Snake River Plain, the predicted warming trends for this region may generate the biophysical conditions favored for cheatgrass establishment.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Effectively control and restore areas dominated by invasive, nonnative annual grasses at a rate greater than the rate of	Implement large-scale experimental activities to remove cheatgrass and other invasive annual grasses through various	Support the development of a framework for a national invasive species Early Detection and Rapid Response (EDRR) program (DOI 2105). Locate and coordinate installation of long-term studies and subsequent monitoring to test the efficacy of large-scale application of integrated pest management programs that include chemical, mechanical, biological,	Greater Sage-Grouse and other sagebrush-steppe dependent species

Objective	Strategy	Recommended Action(s)	Target SGCNs
the spread.	tools (DOI 2015).	newly registered biocides, and subsequent restoration practices (DOI 2015). Support the use of Plateau® herbicide in controlling cheatgrass. Promote certified weed-free seeds/forage (Idaho Sage-grouse Advisory Committee 2006). Work with County Cooperative Weed Management Areas to prevent the introduction, reproduction, and spread of designated noxious weeds and invasive exotic plants.	

Target: Alpine & High Montane Scrub, Grassland & Barrens

The Challis Volcanics Section contains a relatively large area of alpine landcover (2%) relative to other sections in Idaho. Most alpine habitats are within the newly designated Jim McClure–Jerry Peaks, Hemingway–Boulders, and White Clouds wilderness areas. Alpine communities are found at elevations ranging from 2,100 to 3,650 m (7,000 to 12,000 ft) and occur in notable extents in the Salmon River, White Knob, and Pioneer mountain ranges. Wind and its effect on snow movement has a strong local effect, producing wind-scoured fell fields, dry turf, snow accumulation heath communities, and short growing season snowbed sites. Fell fields are typically free of snow during the winter as they are found on ridgetops, upper slopes and exposed saddles, whereas dry turf is found on gentle to moderate slopes, flat ridges, valleys, and basins where soils are relatively stabilized and water supply is more constant. Vegetation occurs as a mosaic of small patch plant communities. Alpine bedrock and scree types consist of exposed rock and talus in steep upper mountain slopes and windswept summits. Sparse cover of forbs, grasses, low shrubs, and scrubby trees may be present with total vascular plant cover typically less than 10–25%. The hydrology is strongly associated with snowmelt and springs which often sustain high mountain lakes. Backcountry recreation use includes hiking, fishing, backpacking, hunting, trapping, and horse-packing in summer/fall, and snowmobiling and skiing in winter. Alpine communities of this section provide nesting habitat for Black Rosy-Finch, and year-round habitat

Chinese Wall, Railroad Ridge © 2011 Beth Waterbury

for Hoary Marmot. Mountain Goats occupy alpine areas with sufficient steep, rocky escape terrain. Winter distribution concentrates on wind-scoured ridges and south-facing slopes where forage is available. Wolverines are strongly associated with alpine climatic conditions and habitats, particularly in summer.

Target Viability

Good. A large portion of alpine habitats in this section are protected as Wilderness Area, Wilderness Study Areas or Roadless Areas. Remaining alpine habitats are characterized as "de facto" wilderness due to remoteness, minimal roads and infrastructure, and generally inhospitable conditions for human habitation. Recreational activities are perceived as being low density and low impact on alpine habitats and wildlife. Alpine-associated biota are sensitive to climatic factors and are likely to have low adaptive capacity to climate change.

Prioritized Threats and Strategies for Alpine & High Montane Scrub, Grassland & Barrens

High Rated Threats to Alpine & High Montane Scrub, Grassland & Barrens in the Challis Volcanics

Changes in precipitation & broad-scale hydrologic regimes

Observed and predicted trends in climate vary widely across Idaho because of its complex topography. Nowhere is this variation more pronounced than in alpine habitats, which contain some of the sharpest environmental gradients found in continental regions. Despite the buffering effect of complex terrain, climate model projections for Idaho and the Pacific Northwest predict progressively warmer and wetter conditions, with worsening summer drought. Given projected temperature increases, the region is expected to transition from a snow-dominated system to one more rain dominated. Changes in the length and depth of snow cover may influence the composition and distribution of alpine flora and fauna. Overall, high-elevation species ranges are expected to contract as a result of vertical migration, because the amount of mountainous land area decreases as one gains elevation and less area is available for species to inhabit. The most vulnerable species may be those that are genetically poorly adapted to rapid environmental change, reproduce slowly, disperse poorly, and are isolated or highly specialized.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase understanding of adaptation responses of alpine biota to climate change.	Support and conduct research into ecological aspects of climate change in alpine systems.	Work with researchers to develop models to predict how wildlife species will cope with changing climatic and environmental conditions. Conduct wildlife species vulnerability assessments supported by predictive models referenced above. Use long-term Mountain Goat population survey datasets for to evaluate occupied habitats in a changing climate.	Golden Eagle, Clark's Nutcracker, Black Rosy-Finch, Wolverine, Mountain Goat, Bighorn Sheep, Hoary Marmot, SGCN Grasshoppers, Pollinators
Maintain connectivity	Identify and secure a	Identify, assess, and prioritize critical connectivity gaps for a range of alpine-	Golden Eagle, Clark's

Objective	Strategy	Recommended Action(s)	Target SGCNs
among patchy alpine habitats.	connected network of alpine habitats to facilitate dispersal, migrations, and range shifts caused by climate change.	associated wildlife species. Work with communities, government agencies, academia, and organizations to identify opportunities for maintaining and restoring landscape connectivity.	Nutcracker, Black Rosy-Finch, Wolverine, Mountain Goat, Bighorn Sheep, Hoary Marmot, SGCN Grasshoppers, Pollinators

Species designation, planning and monitoring

Alpine systems are challenging to inventory due to logistical difficulties of access, short growing or reproductive seasons, and variable weather influenced by high mountain topography. Consequently, population data are lacking for many alpine-associated species. Concerns about the status of alpine obligates in the face of climate change have underscored the need to gather data on all aspects of their ecology, distributions, and populations. Alpine SGCN for which significant data gaps exist are addressed below. These species could be effectively monitored through a multi-species monitoring approach.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Determine status of SGCN alpine obligates.	Conduct surveys and implement long-term monitoring programs for Black Rosy-Finch.	Conduct breeding season surveys to determine distributions and characterize nesting habitat. Implement monitoring programs in occupied habitats. Monitor nonbreeding populations to better understand the scale and scope of threats in anthropogenic environments.	Black Rosy-Finch
	Conduct surveys and implement long term monitoring programs for Hoary Marmot.	Conduct breeding season surveys to determine distributions and characterize alpine habitats. Implement monitoring programs in occupied habitats. Assess the importance of predation as a mortality factor and identify important predators.	Hoary Marmot
	Conduct surveys and implement long-term monitoring for a suite of alpine invertebrates.	Conduct surveys and monitoring for SGCN alpine associate grasshoppers. Conduct surveys and monitoring for SGCN pollinators.	A Grasshopper (*Argiacris keithii*), A Grasshopper (*A. militaris*), Spur-throated Grasshopper Group, Pollinators

Spotlight Species of Greatest Conservation Need: Black Rosy-Finch

Black Rosy-Finch on winter range © 2014 Beth Waterbury

The Black Rosy-Finch is an uncommon songbird that breeds in alpine habitats of the Intermountain West. In Idaho, its breeding range is patchily distributed in high elevation peaks of the state's central mountains complex. Breeding habitat includes cliff crevices and large-boulder rock slides providing nest sites with protection from falling rocks, rain, hail, and ground predators. Nests are usually placed on north-facing cliffs overlooking snowfields or glaciers. These surfaces collect windblown insects and seeds on which the Black Rosy-Finch feeds, and may be a required habitat feature for nest-site selection (Johnson 2002). Black Rosy-Finches lay 5 eggs and raise 1 brood per breeding season, fledging from 24 July to 28 August. Winter range includes alpine areas to lowlands where wind or patchy snow cover exposes seed-feeding areas. In Idaho, winter range extends south and east of the central Idaho mountains but not further north.

The Challis Volcanics Section contains a large proportion of Idaho's breeding and wintering habitat for the Black Rosy-Finch. Prime breeding habitats include the high alpine peaks of the Hemingway–Boulders, White Clouds, and Jim McClure–Jerry Peak Wilderness Areas, and the Pioneer and White Knob mountains. In winter, Black Rosy-Finches can be found in large mixed flocks with the more abundant Gray-crowned Rosy-Finch, occasionally visiting bird feeders in rural residential areas.

Due to the inaccessibility of their alpine nesting habitat and nomadic winter behavior, Black Rosy-Finches are among the least studied of North American birds. As a result, there is currently no information on population trend for this species rangewide or within Idaho. Most high-altitude breeding areas are within protected areas or are largely protected because of their remoteness. However, Black Rosy-Finch is identified on The State of the Birds 2014 Yellow Watch List due to its small population, narrowly distributed breeding population, and decline in the future suitability of breeding habitat. The potential impacts of global warming on alpine breeding habitat (loss of permanent snowfields, rising tree lines) are the most pressing concerns for this unique species.

Spotlight Species of Greatest Conservation Need: Hoary Marmot

<Placeholder for next draft>

Hoary Marmot © 2011 Beth Waterbury

Target: Riverine–Riparian Forest & Shrubland

This system is characterized by riparian forests and woodlands contiguous to and affected by surface and subsurface water. Riverine–riparian systems provide important wetland functions (e.g., water quality protection, flood control, fish and wildlife habitat) disproportionate to their small areal extent (<1%) in this section. Riparian systems are highly variable in size, composition, and structure, reflecting the complex relief and geology of this section.

Big Wood River © 2012 Talo Pinto

The Big Wood and Little Wood rivers are southerly trending systems draining the Boulder and Pioneer mountains of this section. At montane to subalpine

elevations, riparian forests and woodlands occur in both wide glacial-carved valley bottoms and narrow, high gradient tributaries where fluvial landforms (e.g., gravel bars) are frequently absent. At these upper elevations, forested riparian communities are dominated by Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), lodgepole pine (*Pinus contorta*), or quaking aspen (*Populus tremuloides*). These communities are tolerant of periodic flooding and high water tables, often supported by snowmelt moisture. In the lower forested zone and below lower tree line, riparian forests and woodlands occur along streams or on river floodplains receiving annual to episodic flooding, including major deposition events. The Big Wood River and mid-sections of the Little Wood River support broad-leaved deciduous forests commonly dominated by black cottonwood, (*Populus balsamifera* ssp. *trichocarpa*) with lesser amounts of Rydberg's cottonwood (*P. acuminate*), and occasional quaking aspen (*P. tremuloides*). Riparian forests are often in mosaic with tall willow shrublands and diverse herbaceous understories. Riparian systems in the Big Wood River drainage have been fragmented and impaired by a number of activities including livestock grazing, recreation, water development (e.g., irrigation diversions, hydropower development, wells), and housing development.

The northerly trending drainages of this section include the Salmon River mainstem, the East Fork Salmon River, and a mid-elevation reach of the Middle Fork Salmon River. At higher elevations, riparian systems contain the conifer and aspen woodlands that line montane and subalpine streams. At mid-montane elevations to below lower tree line, tree species typically present include black cottonwood, quaking aspen, Douglas-fir, and, along the banks of the Middle Fork Salmon River, ponderosa pine. Large bottomlands in the East Fork Salmon River and mainstem Salmon River upstream of Challis have extensive cottonwood galleries, but most have been fragmented or impacted by livestock grazing, diking, and stream channelization. Along the Salmon River upstream from Challis, cottonwood stands are highly fragmented, generally decadent, and often limited to a line of trees at river's edge with few riparian shrubs in the understory. Being in a wilderness area, the riparian communities and streams in the Middle Fork Salmon River drainage are in a natural state and considered in pristine condition (IDFG 2013).

Riverine–riparian systems provide important habitat for a diverse array of aquatic and terrestrial biota, including keystone species such as cottonwood, American Beaver, and salmon. Avian SGCN associated with cottonwood galleries in the Big Wood River drainage include Common Nighthawk and Lewis's Woodpecker. Recent and verified Yellow-billed Cuckoo records exist for the Big Wood River immediately downstream from the Challis Volcanics section boundary. Riparian systems along the Big Wood and Little Wood rivers support productive streams for Rainbow Trout, Brown Trout, Brook Trout, Mountain Whitefish, the endemic Wood River Sculpin, and aquatic invertebrates. Riverine-riparian systems of the Salmon River and its tributaries provide key habitat for natural spawning populations of spring/summer Chinook and summer Steelhead, as well as native fluvial and resident Redband Trout, Westslope Cutthroat Trout, Bull Trout, and Mountain Whitefish. Shaded reaches of Salmon River mainstem tributaries provide critical thermal refugia for anadromous and resident fish species during the summer months. The continued connectivity and reconnection of these riverine systems is vital to achieving sustainable fisheries in this region. Riverine-riparian habitats in the Salmon River drainage also support numerous aquatic invertebrates (e.g., Western Pearlshell, mayflies, caddisflies), breeding populations of amphibians (e.g., Western Toad), and avian SGCN including Harlequin Duck, Common Nighthawk, and robust populations of Lewis's Woodpecker. The interspersion of cliffs

and rock outcrops in close proximity to riparian habitats provides abundant roosting and foraging habitat for bats in this section.

Target Viability

Fair. The major rivers and tributaries and associated riparian habitats of this section have experienced substantial anthropogenic impacts. In the Big Wood River drainage, the development of irrigation projects, urbanization (e.g., home building, road construction), and conversion to cropland have resulted in degradation, fragmentation, and permanent losses of riparian habitat. The natural hydrograph of most stream systems in this drainage is altered by dams, diversions, and wells (Jankovsky-Jones 1997). The Little Wood River is impacted by a reservoir and channelization of lower reaches. Lateral flows (across the flood plain) are limited by channelization, levees, instream structures such as rip rap, and emergency flood control structures. Diversion canals are present on the Big Wood downstream of Hailey for agriculture use. Grazing practices have impacted the structure and species composition of riparian areas throughout the drainage, affecting the long-term viability of cottonwood stands on the Big Wood River and other streams (Jankovsky-Jones 1997). At upper elevations, recreation contributes to compaction of soils, elimination of vegetation, and reduction of woody species regeneration. Many of the Salmon River drainages have good to excellent viability due to the free-flowing status of the Salmon River and its primary tributaries (e.g., no manmade barriers), large connected habitats for listed salmonids, and an abundance of roadless and little-roaded federal lands with high ecological integrity. These areas account for a substantial portion of the section and serve as habitat strongholds for multiple species of fish and wildlife. However, areas of poor to fair riparian viability attributed to irrigated agriculture, livestock grazing, road construction, logging, and mining do occur. These activities often result in alteration of stream hydrographs and lowered water quality due to loss of thermal cover along streams, loss of filtering functions, and decreased bank stability.

Prioritized Threats and Strategies for Riverine–Riparian Forest & Shrubland

High Rated Threats to Riverine–Riparian Forest & Shrubland in the Challis Volcanics

Water diversions

Diversion of water from the rivers and streams in the Challis Volcanics Section was coincident with Euro-American settlement of the region beginning in the 1860s. Water diversions co-occurred with numerous other human impacts to riparian systems including harvest of riparian forests for fuel, shelter, and land clearing, livestock grazing, wetland drainage, mining, and logging. As noted above, hundreds of surface water diversions exist in this section in support of agriculture. The engineering of water diversions constitute a major perturbation of fluvial processes and riparian conditions in this arid landscape. Water diversions can drastically alter stream flow regimes producing many synergistic effects including disruption of flood and channel forming processes, floodplain/stream linkages, recruitment of riparian vegetation, fish migration and access to suitable spawning and rearing habitat, and water temperature regimes

for coldwater fish. High water temperatures typically coincide with high ambient air temperatures in late summer. Agricultural water diversions are at their highest and streamflows generally are at their lowest during this time frame. Reductions in streamflow, coupled with warm air temperatures, can create thermal barriers that block migration of adult native salmonids to spawning grounds, decrease juvenile salmonid rearing habitat, and result in poor growth and survival (Maret et al. 2005). Human activities that remove riparian shading can accentuate this increased water temperature.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Minimize impacts to riverine-riparian systems from water diversions.	Correct fish passage impediments such as irrigation diversions and dewatered stream segments that delay or restrict anadromous and resident fish access to thermal refugia and to spawning and rearing tributaries.	Work with irrigation districts, landowners, the Upper Salmon Basin Watershed Project, state and federal agencies, and other partners to identify and screen or repair irrigation diversions where needed. Modify diversion structures (e.g., gravel pushup dams) to improve connectivity for anadromous and resident fish. Continue evaluation of the current screening program to explore opportunities for improvements.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon
	Improve minimum streamflows and fish passage through irrigation efficiencies.	Continue to participate and support efforts through the Upper Salmon Basin Watershed Project and other voluntary, collaborative programs to transfer or purchase water rights to provide adequate flows in main-rivers and tributaries. Pursue the reconnection of tributaries through improved irrigation delivery systems, ditch consolidations, permanent head gates, stream channel improvements, dry year lease options, and/or permanent leases. Continue to improve flows in mainstem river reaches during peak irrigation season. Maintain or improve in-stream flows through critical review of water right applications, and by working with private irrigators and irrigation districts to pursue water savings projects. Work with IDWR on strategies such as water lease/rentals, sources switches, and minimum flow agreements. Work with IDWR on strategies to provide enhanced flows.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon
	Reduce instream water temperatures.	Work with state and federal agencies, irrigation districts, and landowners on developing wetlands on irrigation returns to improve water quality.	Pacific Lamprey, Steelhead, Sockeye

Objective	Strategy	Recommended Action(s)	Target SGCNs
		Work with state and federal agencies, irrigation districts, and landowners to restore and protect shade-providing and bank-stabilizing riparian vegetation.	Salmon, Chinook Salmon

Active riparian vegetation removal

Many of the same attributes that contribute to the high productivity and biodiversity of riparian systems are of high economic value to human society. Consequently, the floodplains of the Challis Volcanics Section are productive for not only their complex wildlife habitats and linkages to aquatic biota, they are the most productive lands for agriculture and highly desirable for human dwellings. This is reflected in the high proportion of private landownership in the low ground topography of this section. Livestock, hay, and grain production agriculture is prevalent along the major tributaries and rivers in this section. Clearing and occasional burning of riparian vegetation is commonly employed to maximize croplands and set back riparian succession. Development of "riverfront" homesites has accelerated loss and fragmentation of riparian habitat through clearing to improve river views and to create fire-defensible space around structures. Riparian vegetation removal may be subsidized under government programs to reduce the risk of fire in wildland-urban interface environments.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Conserve, maintain and restore riparian habitats on public and private lands.	Increase public awareness of the multiple values and benefits of riparian habitat.	Incorporate and implement appropriate riparian management and stewardship guidelines in public and private land management programs/decisions. Distribute *Stream Care: A Guide for Property Owners in the Upper Salmon River Watershed* pamphlet to riverfront landowners. Incorporate riparian ecology information and management guidelines into wildland fire education programs. Provide riparian vegetation objectives to land management agencies where grazing, development, or other activities have degraded riparian zones. Designate suitable sites as Important Bird Areas to foster community engagement in riparian conservation.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad, Common Nighthawk, Lewis's Woodpecker, all SGCN bats, Fisher, all SGCN bivalves, Pollinators
	Conserve riparian habitats through land use planning.	Develop land use ordinances that establish adequate building setbacks and limits on riparian vegetation removal on all watercourses, including ephemeral streams. Encourage policies of no net loss for late-seral cottonwood forests. Negotiate variances on vegetation standards for Army Corps of Engineers-maintained levees.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad, Common Nighthawk,

Objective	Strategy	Recommended Action(s)	Target SGCNs
		Minimize vegetation clearing for road building on public lands.	Lewis's Woodpecker, all SGCN bats, Fisher, all SGCN bivalves, Pollinators
	Conserve riparian habitats through active restoration and protection programs.	Restore riparian vegetation through planting of native trees and shrubs. Identify and survey intact blocks of mature cottonwood forest, using agency or citizen scientists. Use voluntary cooperative efforts (i.e., Conservation Reserve Enhancement Program) and incentive programs to conserve, maintain and restore riparian habitats on private lands. Work with US Forest Service, BLM, and grazing permittees to reestablish healthy riparian vegetation through livestock management improvements. Participate in grazing allotment management plan reviews. Work with agencies and landowners to eliminate grazing practices that negatively impact riparian and aquatic habitats. See recommended actions under Improper livestock grazing management section below.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad, Common Nighthawk, Lewis's Woodpecker, all SGCN bats, Fisher, all SGCN bivalves, Pollinators

Improper livestock grazing management

Riparian areas have historically and continue to be of vital importance to the livestock industry due to their productivity and nexus with water. Livestock tend to congregate in riparian and wetland areas and use the vegetation much more intensively than the vegetation of adjacent uplands. Many of the broad floodplain riparian zones of the Challis Volcanics Section, formerly complex mosaics of deciduous forest, beaver marsh, and wet prairie, have been converted to simple agro-ecosystems of pastures and croplands. Within public lands grazing allotments, headwaters and tributaries have maintained relatively good riparian functionality. However, downstream lower gradient stream reaches have been considerably altered by the effects of forage removal, soil compaction, streambank trampling, channelization, and the introduction of invasive plants. The resulting losses of ecosystem structure and composition, particularly in riparian stands of cottonwood, willow, and aspen, decrease riparian habitat value for terrestrial wildlife (e.g., avian nesting) and aquatic biota.

Because riparian conditions are highly variable from site to site (e.g., hydrology, soils, climate, plant species), no single livestock grazing strategy will fit all situations. Ideally, livestock grazing management plans would be tailored to incorporate site-specific riparian habitat objectives. Livestock grazing systems that combine periods of use with nonuse, such as deferred-rotation, rest-rotation, high intensity-low frequency, and short-duration, can be effective management

tools to increase livestock productivity, achieve riparian habitat objectives, and maintain biological diversity.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Maintain riverine health and riparian habitat quality in the presence of livestock grazing.	Develop and implement livestock grazing management regimes that are compatible with riparian conservation objectives.	Work with land management agencies, grazing permittees, and private landowners to determine site-specific riparian habitat objectives and tailor grazing management plans to help meet those objectives. Maintain proper stocking rates, season of use, and livestock distribution to protect riparian and adjacent upland habitats. Consider excluding livestock from riparian areas with high risk and poor recovery potential when there is no practical way to protect those riparian areas while grazing adjacent uplands. Locate livestock water gaps on short, straight, stable sections of streams with gently sloped banks. Manage riparian pastures as separate units in a rotation grazing system. Ensure adequate residual vegetative cover is left after grazing to ensure soil stabilization during high flows and to provide for seasonal cover and forage for wildlife. Maintain a diversity of riparian woodland age classes to provide a long-term source of mature trees, multiple vegetation layers, and snags. Develop water and shade in upland areas to help distribute livestock pressure from riparian areas. Ensure that stock tanks are equipped with escape ramps to prevent small birds and mammals from drowning. Improve livestock distribution and forage use by placing salt and mineral blocks away from riparian areas and adjacent uplands. Locate livestock handling facilities and collection points outside of riparian areas. Control invasive weeds to prevent colonization in sensitive riparian habitats.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad, Sandhill Crane Common Nighthawk, Lewis's Woodpecker, all SGCN bats, Fisher, all SGCN bivalves, Pollinators

Changing precipitation and broad-scale hydrologic regimes

Anthropogenic climate change is altering stream hydrology and its associated biota in the Rocky Mountain West (Rieman and Isaak 2010). The timing of stream runoff steadily advanced during the latter half of the 20th century and now occurs 1 to 3 weeks earlier due largely to

concurrent decreases in snowpack and earlier spring melt (Stewart et al. 2005). Climate models predict a trend towards a decrease in snow water equivalent and a general increase in winter precipitation in the form of rain, particularly at lower elevations. Generally drier conditions are anticipated for the southern Rocky Mountains, inclusive of the Challis Volcanics Section. Climate change could profoundly impact aquatic and riparian systems by increasing water temperatures, variability in flow timing and amount, and risk of extreme climate events such as floods, droughts, and wildfires. These stresses, in turn, may effect changes in the composition of the riparian plant community and its susceptibility to invasions by invasive plants. Projected changes may detrimentally impact aquatic and riparian species, such as Chinook Salmon, Bull Trout, Wood River Sculpin, Lewis's Woodpecker, and aquatic invertebrates that are the focus of conservation efforts in this section.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase capacity for water storage to combat the effects of climate change.	Restore American Beaver (*Castor canadensis*) as a climate adaptation strategy.	Develop plan to restore American Beaver to unoccupied drainages of Challis Volcanics Section. Identify key watersheds. Conduct outreach to engage stakeholders in key areas. Do site preparation work. Manage trapping seasons to ensure that beavers continue to contribute to healthy riparian systems in the Challis Volcanics Section. Translocate beaver from source. Monitor actions.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad, Sandhill Crane Common Nighthawk, Lewis's Woodpecker, all SGCN bats, Fisher, all SGCN bivalves, Pollinators
	Implement irrigation efficiencies to improve minimum streamflows.	Purchase instream water rights or negotiate flow agreements with water users to enhance instream flows. Consolidate irrigation ditches to increase water savings.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad
Increase acreage of riparian habitat in protected status.	Develop policies, programs, and incentives to conserve highest quality riparian habitats.	Identify, assess, and prioritize largest and most contiguous patches of cottonwood forest and target for protection. Conserve highest quality cottonwood forests through land exchanges, conservation easements, or purchase.	Pacific Lamprey, Steelhead, Sockeye Salmon, Chinook Salmon, Western Toad, Sandhill Crane Common Nighthawk, Lewis's Woodpecker, all SGCN bats, Fisher, all SGCN bivalves,

Objective	Strategy	Recommended Action(s)	Target SGCNs
			Pollinators

Development in floodplains

The Big Wood River valley has undergone extensive and rapid development in the last decade with most of this development taking place within and adjacent to riparian areas. This has resulted in the conversion of complex riparian ecosystems into manicured, park-like communities with very simple understories dominated by nonnative plant species, some of which are invasive. Changes to water quality and increased use of pesticides can have detrimental effects on fish and aquatic invertebrates. Increased human activity in these riparian areas can reduce their suitability as breeding and foraging habitat for species such as Lewis's Woodpecker, Silver-haired Bat, Hoary Bat, and Common Nighthawk. The Big Wood River floodplain supports a significant portion of the late seral cottonwood galleries in this section. Development not only reduces the extent of existing galleries, but often inhibits recruitment of young cottonwoods to perpetuate the community. Increasing residential development is evident along the lower East Fork Salmon River and mainstem Salmon River, but at relatively modest levels.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Minimize loss and degradation of riverine and riparian habitats due to residential development.	Seek improved land and water management practices that significantly protect and enhance fish and wildlife habitat.	Work closely with county planning and zoning agencies and IDWR to prevent channel and riparian degradation and development in natural flood plains. Work with government agencies, private landowners and developers, and conservation groups to make protection and enhancement of fish and wildlife habitat and water quality a primary concern in land use decisions. Ensure restoration of habitat or mitigation of habitat loss whenever possible. Provide riparian vegetation objectives to land management agencies where grazing, development, or other activities have degraded riparian zones.	

Target: Springs & Groundwater-Dependent Wetlands

These mesic systems are scarce resources in the semi-arid Challis Volcanics Section, and are generally regarded as biodiversity hotspots. These habitats are typically seeps, springs, and wet meadows occurring on gentle to steep slopes from low elevation floodplains to alpine forests. Meadows are often dominated by rhizomatous graminoids, such as sedges, grasses, and rushes, and forbs are diverse and often lush. Unique examples of this type include the East Fork of the Salmon River and Little Wood River/High Five wetlands in Custer and Blaine Counties, respectively.

The interface of these mesic systems with adjacent arid uplands creates the ultimate platform for biotic diversity. Springs, seeps, and wet meadows function as critical surface water sources linking uplands, riparian zones, and stream channels. They serve as important foraging areas for avian communities, particularly if associated with nearby riparian or forest habitats (Saab and Rich 1997). In mosaics with sagebrush steppe, springs, seeps, and wet meadows are a critical habitat component for several avian SGCN including Greater Sage-Grouse, Sandhill Crane, Long-Billed Curlew, Burrowing Owl, and Short-Eared Owl (Rich et al. 2005). The grasses present in mesic meadows are important in providing food and cover for birds directly, and in providing a substrate for a volume and diversity of insects which serve as additional food items. Connelly et al. (2004) recognize wet meadows as important late brood rearing habitat for Sage-Grouse, characterized by relatively moist conditions with succulent forbs in or adjacent to sagebrush cover. As elements within forested communities, these systems provide important breeding habitats for amphibians. Because of the abundance of insects, these systems are important foraging sites for bats. These habitat types also provide critical fawning/calving areas for Mule Deer, Pronghorn, and Elk.

Corral Basin, Broken Wagon Creek © 2015 Beth Waterbury

Target Viability

Poor. These systems form relatively rare islands of robust herbaceous vegetation within large patches of more xeric systems such as sagebrush steppe, lower montane grasslands, and dry lower montane forests. These sites are highly attractive to domestic livestock and wildlife as sources of palatable green forage and free water. A legacy of improper livestock grazing and, in some areas, associated spring developments to provide additional livestock water has altered the structure, composition, and function of these habitat types. Springs, seeps, and wet meadows are also attractive features to recreationists whose use may cause soil compaction and erosion, alter hydrologic processes, destroy vegetation, and facilitate the colonization of invasive weeds.

Prioritized Threats and Strategies for Springs & Groundwater-Dependent Wetlands

Very High Rated Threats to Springs & Groundwater-Dependent Wetlands in the Challis Volcanics

Changing precipitation and broad-scale hydrologic regimes

Precipitation is critical to the existence of springs, seeps, and groundwater-dependent wetlands, and the size, frequency, and duration of precipitation events are key factors influencing their recharge and persistence. Climate change is expected to decrease ground and surface water quantity and increase the duration and intensity of drought, and these systems will be a direct indicator of these changes. Decreased discharge would likely result in reduced flow from springs, lower base flow in feeder streams, and loss of groundwater-fed wetlands. Factors such as higher air temperatures and evaporation could further exacerbate drying trends. Springs, seeps, and meadows in poor or compromised ecological condition may lack the resiliency needed to persist under drought conditions. The implications for Greater Sage-Grouse and sympatric wildlife are concerning, as springs, seeps, and wet meadows within sagebrush steppe habitats are often the only natural water sources across vast areas.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase health and resiliency of springs, seeps, and groundwater-dependent wetlands to combat the effects of climate change.	Implement climate mitigation strategies to improve the resilience and resistance of springs, seeps, and groundwater dependent wetlands.	Realign, restore, and renovate key mesic systems that are not functioning properly. Reduce or eliminate additive nonclimate ecosystem stresses (e.g., high road densities, water depletions, water pollution). Locate and collect locally-sourced seeds of desirable native plant species for revegetation and restoration efforts. Explore the use locally produced biochar to sequester carbon, reduce erosion, and enhance soil productivity and water retention. Ensure that administrative and permitted activities on public lands do not contribute to the reduction of surface or groundwater that supplies springs, seeps, small ponds, and wetlands. Monitor ecological condition at springs, seeps, and groundwater-dependent wetlands for future evaluation of possible effects from climate change.	Western Toad, Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Sandhill Crane, Long-billed Curlew, Burrowing Owl, Short-eared Owl, Common Nighthawk, all SGCN bats, Bighorn Sheep, Monarch, Pollinators

High Rated Threats to Springs & Groundwater-Dependent Wetlands in the Challis Volcanics

Improper livestock grazing

Livestock impacts to springs, seeps, and wet meadows are widespread in the Challis Volcanics Section. Livestock tend to congregate in riparian and wetland areas due to the availability of palatable forage and prolonged plant phenology, particularly during the hot grazing season. Direct impacts to vegetative composition and productivity result from herbage removal by foraging livestock. Where utilization is high for a sequence of years, the composition of the plant community may change as the more palatable species lose vigor and decrease throughout the site. This impact is heightened during drought periods. Trampling by livestock can penetrate, compact, and reconfigure soil into pugs and hummocks. Soil compaction restricts root growth, reduces soil water-holding capacity, reduces soil productivity, and contributes to water runoff and soil erosion (Fitch and Ambrose 2003).

Objective	Strategy	Recommended Action(s)	Target SGCNs
Manage livestock grazing to improve springs and ground-water dependent systems.	Manage grazing intensity, frequency, and/or season of use to provide sufficient opportunity to encourage plant vigor, regrowth, and organic matter contribution to soils.	Work with land management agencies, grazing permittees, and private landowners to determine site-specific spring/seep/wetland objectives and tailor grazing management plans to help meet those objectives. Selectively fence livestock from springs, seeps, wetlands, and restoration sites and provide off-stream water sources. Limit duration of hot season use. Employ rest/rotation grazing systems. Build in support for an option of "grass reserve units." Manage the timing of grazing to minimize compaction of medium texture soils that are seasonally saturated, and the intensity of use to minimize churning of soils that are saturated. Seek and apply the best possible tools and techniques to influence the distribution of livestock. Ensure adequate residual vegetative cover is left after grazing to ensure soil stabilization during high flows and to provide for seasonal cover and forage for wildlife. Improve livestock distribution and forage use by placing salt and mineral blocks away from springs/seeps/wetlands and adjacent uplands. Locate livestock handling facilities and collection points outside of springs/ground-water dependent wetlands.	Western Toad, Greater Sage-Grouse, Ferruginous Hawk, Golden Eagle, Sandhill Crane, Long-billed Curlew, Burrowing Owl, Short-eared Owl, Common Nighthawk, all SGCN bats, Bighorn Sheep

Target: Lakes, Ponds, & Reservoirs

Lakes, ponds, and reservoirs are infrequent in the Challis Volcanics Section (less than 1% of the land area), but they are of high importance from standpoints of fish and wildlife diversity, water storage, and recreation. These ecosystems include aquatic and wetland habitats in permanently to seasonally flooded natural lakes and deep ponds in topographic depressions. Examples in this section include Jimmy Smith Lake in the East Fork Salmon River drainage, Mosquito Flats Reservoir in the Salmon River Mountains, and Little Wood and Fish Creek reservoirs in the Little Wood River Valley. Also included in this system are numerous high mountain lakes occurring at upper montane, subalpine, and alpine elevations. They typically occur in glacial cirques and hanging valleys where bedrock or moraine deposits form the depression containing the lake or pond. The prevalence of rugged mountain topography in this section forms hundreds of high mountain lakes. These can occur as a series (e.g., paternoster lakes) and in hanging valleys where 1st order creeks connect many of the lakes.

Jimmy Smith Lake © 2015 Greg Painter

Lakes, ponds, and reservoirs of this section provide rare and strategic "stepping stone" refugia for waterbirds, waterfowl, and shorebirds migrating through the arid, intermountain expanse of the Pacific Flyway. Open water habitat and lacustrine fringe wetlands provide breeding and foraging habitat for many SGCN including Western Toad, Sandhill Crane, Common Nighthawk, and most SGCN bats. Many high mountain lakes harbor populations of introduced Cutthroat Trout (*Oncorhynchus clarkii*), Rainbow Trout (*O. mykiss*), Brook Trout (*Salvelinus fontinalis*), and Arctic Grayling to provide recreational opportunities for anglers. Little Wood Reservoir and Jimmy Smith Lake are regionally important as year-round fisheries.

Target Viability

Viability of these lacustrine habitats is considered good. Long-term viability of the larger lakes and reservoirs in this section is deemed stable due to priority maintenance of human beneficial uses (irrigation, recreation) that directly and indirectly conserve fish and wildlife habitats. Viability of high mountain lake systems is generally considered good due to very low levels of human disturbance and protections afforded by Roadless Areas, Wilderness Study Areas, and the inherent remoteness and isolation of these lakes. Ecological and biological aspects of maintaining healthy amphibian populations and potential impacts to downstream native fish

populations are considered in determining how alpine lakes are managed (IDFG 2013). The primary issues in this system are short- and long-term impacts of climate change.

Prioritized Threats and Strategies for Lakes, Ponds, & Reservoirs

High Rated Threats to Lakes, Ponds, & Reservoirs in the Challis Volcanics

Changing precipitation and broad-scale hydrologic regimes

Climate models predict a trend towards a decrease in snow-water equivalent and a general increase in winter precipitation in the form of rain, particularly at lower elevations. Generally drier conditions are anticipated for the southern Rocky Mountains, inclusive of the Challis Volcanics Section. Snowpack amount strongly affects the hydrological budget of lakes, ponds, and reservoirs in this section, as well as the timing of ice-off. Declines in snowpack and warming temperatures may reduce the volume and area of open water habitat used by fish and wildlife. Predicted changes in ambient air temperatures will subsequently affect the thermal characteristics of lakes, ponds, and reservoirs. Resulting warmer water temperatures could lead to enhanced nutrient inputs and affect water quality by promoting algal blooms and impairing food web functions and seasonal patterns of productivity.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Increase health and resiliency of lakes, ponds, and reservoirs to combat the effects of climate change.	Implement climate mitigation strategies to improve the resilience and resistance of lakes, ponds, and reservoirs.	Research options for managing this habitat under forecasted climate models. Work with other relevant agencies, organizations, and user groups across the Challis Volcanics Section to address climate change mitigation for lakes, ponds, and reservoirs under forecasted conditions (i.e., drought) to include development of proactive management alternatives implementable at the local project level. Reduce or eliminate additive nonclimate ecosystem stresses (e.g., recreational impacts, water inefficiencies, water pollution). Ensure that administrative and permitted activities on public lands do not contribute to the reduction of surface or groundwater that supplies lakes, ponds, and reservoirs. Monitor ecological condition at lakes, ponds, and reservoirs for future evaluation of possible effects from climate change. Conduct microclimate monitoring to better identify and understand local pockets of environmental opportunity to enhance habitat resistance to climate induced stressors. Support efforts to increase public awareness of climate change impacts to local landscapes and wildlife dependent on them.	Western Toad, Sandhill Crane, Long-billed Curlew, Common Nighthawk, Silver-haired Bat, Hoary Bat, Western Small-footed Myotis, Little Brown Bat

Target: Wolverine

The Wolverine is a large, rare mustelid that occupies remote subalpine and alpine habitats of this section. The population in this section is part of the Salmon-Selway core population occupying the central Idaho mountains complex (IDFG 2014). Primary habitats in the Challis Volcanics correspond to public lands managed by Salmon-Challis, Sawtooth, and Payette National Forests. With the recent designation of new Wilderness Areas in the Boulder and White Cloud mountains, the majority of primary wolverine habitat is permanently protected. Other primary habitats are managed as Roadless Areas or for multiple-use. Dozens of historic and contemporary wolverine records exist for this section, and verified observations (e.g., specimens, DNA samples, diagnostic photos, captures) are regularly reported for all mountain ranges in this section.

Wolverine kits at Snow Lake, White Cloud Peaks © 2012 Bryan Tilly

No "Tier I" Wolverine Priority Conservation Areas (PCA) are designated for this section (IDFG 2014). Tier I denotes PCAs with the highest conservation need based on potential wolverine use, cumulative threats, and amount of unprotected habitat. The majority of PCAs in this section ranked "Tier II" based on lower levels of cumulative threats. A few PCAs within the Frank Church River of No Return Wilderness ranked "Tier III," reflecting high proportion of PCA areas in permanent land protection and low cumulative threats. The north-south axis of this section encompasses a continuum in Wolverine habitat suitability, with the north half being within the core of the Salmon-Selway Ecosystem and the southern end being at its periphery. Wolverine populations at this southern extent of the Challis Volcanics may be particularly vulnerable to climate-driven reductions in size and connectivity of habitat islands (Aubry et al. 2007, Schwartz et al. 2009, Copeland et al. 2010).

Target Viability

Fair. Most wolverine habitat in the Challis Volcanics Section can be characterized as core, contiguous habitat, the southern end being the exception. Here, habitat occurs in disjunct "sky island" patches on the periphery of core populations in the Salmon-Selway Ecosystem and the species' overall distribution in North America. Climate warming and shrinking snowcover may amplify the fragmented nature of wolverine habitat in this section resulting in diminished connectivity and a subpopulation more vulnerable to extirpation. The Smoky, Pioneer, and White Knob mountains contain extensive areas of front-country access for licensed trappers and

potential risk of nontarget wolverine capture. Dispersed snow sports recreation and road densities are considered moderate level threats in this section (IDFG 2014).

Prioritized Threats and Strategies for Wolverine

High Rated Threats to Wolverine in the Challis Volcanics

Connectivity, small populations, and extirpation risk

Wolverine populations at the southern end of their current US range (i.e., Challis Volcanics Section) exhibit low effective population sizes (number of individuals in a population who contribute offspring to the next generation), restricted gene flow, and perhaps some degree of population fragmentation. Given populations are small and movement between populations is limited, populations are more susceptible to inbreeding. Genetic exchange with the larger Canadian/Alaskan population is deemed necessary to ensure genetic viability in the long-term. Connectivity between wolverine habitats and subpopulations is critically important to avert further isolation and localized extirpation risk. Climate pattern uncertainty further compounds the challenges to wolverine demography. Climate models tested by McKelvey et al. (2011) predicted that large (>1,000 km^2) contiguous areas of wolverine habitat will likely persist into the 21st century (e.g., northwestern Montana, along the Montana-Idaho border, Greater Yellowstone Area). However, these models predicted that central Idaho may be lost as a population source given highly fragmented spring snow cover and associated loss of connectivity. Consequent loss of habitat suitability (i.e., spring snow cover, warming temperatures) may result in extirpation of wolverines from a significant portion of currently occupied range (Copeland et al. 2010, US Fish and Wildlife Service 2010).

Objective	Strategy	Recommended Action(s)	Target SGCNs
Facilitate connectivity among wolverine subpopulations to enhance genetic exchange and population demographics.	Identify and characterize movement corridors important for maintaining genetic exchange and diversity among wolverine subpopulations.	Refine and aggregate wolverine movement corridor and genetic exchange models to predict existing movement pathways. Contribute wolverine genetic samples to connectivity model analysis.	Wolverine
Conserve habitat to support viable wolverine populations.	Secure appropriate conservation status on priority movement corridors to achieve an ecologically connected network of public/private conservation areas to facilitate migrations, range shifts, and other	Conserve corridors and transitional habitats between ecosystem types through both traditional and nontraditional mechanisms (e.g., land exchanges, conservation easement tax incentives, Land and Water Conservation Fund) to enhance habitat values and maintain working landscapes under climate change. Identify, assess, and prioritize critical connectivity gaps and needs across current conservation areas, including areas likely to serve as refugia in a changing climate. Assist private landowners with information and resources to conserve wildlife corridors across	Wolverine

Objective	Strategy	Recommended Action(s)	Target SGCNs
	transitions caused by climate change.	their properties. Support and strengthen conservation programs (e.g., Farm Bill, Partner for Wildlife, etc.) that provide resources for purposes of conserving wolverine habitat and connectivity. Provide wolverine and other wildlife data and maps to local governments, land managers, and transportation departments to avoid, minimize, or mitigate impacts from new infrastructure developments on wolverine habitats. Continue the partnership with Idaho Transportation Department (ITD) and Federal Highway Administration (FHWA) to develop and monitor traffic volume, wildlife-vehicle collisions, and other metrics needed to identify connectivity and high risk areas for road mortality or road crossing avoidance. Work with ITD to design connectivity and crossing mitigation consistent with FHWA *Handbook for Design and Evaluation of Wildlife Crossing Structures in North America*. Work with ITD to avoid and reduce barriers or impediments to connectivity and crossings.	
Collaborate across multiple jurisdictions and spatial scales to achieve wolverine conservation.	Facilitate local conservation actions tiered to statewide objectives (IDFG 2014).	As warranted, establish and support local working groups to advise conservation activities in Wolverine Priority Conservation Areas.	Wolverine
Support the development and use of inventory and monitoring systems to assess wolverine vulnerability to climate change.	Support, coordinate, and where necessary develop inventory, monitoring, observation, and information systems at multiple scales to detect and describe potential climate impacts on wolverines.	Develop, refine, and implement monitoring protocols that provide key information needed for managing and conserving wolverine and alpine/subalpine communities in a changing climate. Work with researchers to develop regionally downscaled Global Climate Models (using the most current models and emission scenarios) and associated climate indicators (e.g., snow data) to support a wolverine vulnerability assessment. Produce regional to subregional projections of future climate change impacts on physical, chemical, and biological conditions for Idaho ecosystems, particularly alpine and subalpine communities.	Wolverine

Target: Bighorn Sheep

Bighorn Sheep is an iconic species of high cultural, hunting, and watchable wildlife value to Native American Tribes and the public at large. The Challis Volcanics, along with the Idaho Batholith, supports the only native Bighorn Sheep remaining in Idaho. These native Rocky Mountain Bighorn Sheep were never extirpated from the Salmon River drainage and represent the largest populations in the state (IDFG 2010). Bighorn Sheep in the Challis Volcanics Section are patchily distributed from the Middle Fork Salmon drainage in the north to the Pioneer Mountains in the south. Habitat in the Middle Fork Salmon is typified by rugged canyons and dry, coniferous forest-grassland habitats with very low road densities. From the Salmon River Mountains south, habitat grades from sagebrush steppe at lower elevations through dry, coniferous forest-grasslands to alpine at the highest elevations.

Rocky Mountain Bighorn Sheep © 2010 Paul Tessier

Bighorn Sheep populations are managed in Idaho with a separate species management plan (IDFG Bighorn Sheep Management Plan 2010). Sheep occurrence In the Challis Volcanics is defined within 4 contiguous Population Management Units (PMUs), described in detail in the Bighorn Sheep Management Plan (2010): Middle Fork Salmon River, Middle Main Salmon River, East Fork Salmon River, and Pioneers.

The Middle Fork PMU covers the Middle Fork Salmon River drainage including Big Creek and has the largest population of sheep in the state at about 500-550 individuals. Fire has played a substantial habitat management role in the PMU, burning 800,000 acres since 2000 (IDFG 2010). While this has certainly been beneficial to sheep populations, it has also resulted in increased noxious weed invasion. The population appears to still be disease-limited as evidenced by low lamb:ewe ratios. The management direction is to increase population levels by improving habitat and controlling noxious weeds (IDFG 2010).

The Middle Main Salmon River PMU encompasses the tributaries on the west side of the Salmon River between Clayton and Salmon. The population appears to be stable at right around 200 animals. Lamb:ewe ratios rebounded quickly after the early 1990s die-off and remain at about 30 lambs:100 ewes. Because of their proximity to a major highway and agricultural land, these sheep are at risk of disease transmission from domestic farm flocks and increased mortality from vehicle collisions. As with the middle Fork PMU, the management direction is to increase the

population by habitat improvement, noxious weed control, and maintaining separation with domestic sheep and goats.

The East Fork PMU contains the entire East Fork Salmon River drainage as well as a small portion of the tributaries of the upper Salmon River southeast of Stanley. The population reached almost 200 animals in the late 1980s before declining 50% in the early 1990s, much the same as other PMUs. The lamb:ewe ratio declined to around 10 and has not increased. The management direction for this PMU is to increase population levels and will be the focus of increased research effort to determine limiting factors to population growth.

The Pioneers PMU covers much of the upper Big Lost River drainage. While it has been identified as a PMU, it does not have a persistent bighorn population and is not managed to maintain a population. Bighorn Sheep, mainly young rams, are observed here periodically and are probably dispersing from the Lost River population or the East Fork population. Management direction is to work to maintain separation of bighorns and domestic sheep and prevent bighorns that have contacted domestic sheep and goats from returning to their source populations.

Target Viability

Bighorn Sheep are distributed widely across the Challis Volcanics and are in good condition in terms of population structure, disease-free status, and habitat quality. The Middle Fork PMU is a population stronghold and is relatively well protected from disease transmission and further noxious weed infestations. The Middle Main PMU also has a stable population, but may be at a higher risk from disease transmission from adjacent domestic farm flocks. The East Fork PMU may be vulnerable to disease transmission because of dispersing sheep returning to the population from the south where there are several domestic sheep allotments. This PMU may benefit the most from habitat manipulations.

Prioritized Threats and Strategies for Bighorn Sheep

Very High Rated Threats to Bighorn Sheep in the Challis Volcanics

Disease transmission

Bighorn Sheep are vulnerable to disease transmission from domestic sheep and goats throughout most of their range in the Challis Volcanics. Small farm flocks pose a risk primarily where Bighorn Sheep winter range is adjacent to private property. USFS domestic sheep allotments that border or overlap Bighorn Sheep distribution could pose an increased threat of interaction between Bighorn Sheep and domestic sheep and goats. Another possible source of disease transmission to Bighorn Sheep could be incidental contacts with pack goats on backcountry trails. All 4 PMUs have backcountry trails within their boundaries.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Work to reduce the effects of disease on Bighorn Sheep populations.	Advocate and work towards maintaining spatial and temporal separation	Work with willing domestic sheep permittees, USFS, and BLM to identify and implement Best Management Practices (e.g., limit estrus ewes near wild sheep populations, develop effective grazing patterns, track and report missing livestock) to maintain separation between	Bighorn Sheep

Objective	Strategy	Recommended Action(s)	Target SGCNs
	between Bighorn Sheep and domestic sheep and goats.	Bighorn Sheep and domestic sheep and goats. Work with USFS, BLM and other land management agencies to identify appropriate alternative management options. Capture or euthanize foraying wild sheep after contact with domestic sheep or goats (IDFG 2010). Capture or euthanize feral livestock when contact with Bighorn Sheep is suspected or confirmed (IDFG 2010). Encourage double-fencing where appropriate and practical (WAFWA 2007; (IDFG and ISDA 2008). Work with ranchers to seasonally coordinate grazing patterns (WAFWA 2007; IDFG and ISDA 2008).	
Improve education and outreach efforts regarding risks associated with contact between Bighorn Sheep and domestic sheep and goats.	Collaborate with ISDA and Idaho Woolgrowers to develop education and outreach strategies.	Work with a key representative(s) from the livestock production sector to act as a mediator between agencies and producers to open the door to better communications between both groups on science and management issues. Seek out and speak to organized pack goat groups about risk of disease transmission. Develop signs for trailheads with information on avoiding contact with wild Bighorn Sheep.	Bighorn Sheep

High rated threats to Bighorn Sheep in the Challis Volcanics

Motorized recreation

There is a lack of research into the specific effects of OHV use on Bighorn Sheep behavior and habitat use (IDFG 2010). However, the large body of research on other ungulate species indicates that OHV disturbance can have significant impacts on behavior and habitat use (Wisdom et al. 2004). Also, OHVs allow much greater access to the remote places where Bighorn Sheep live. This may result in increased disturbance and displacement, higher potential for illegal harvest, and lower herd productivity. Disturbance from OHVs is less likely for the Middle Fork PMU since most of it is within designated wilderness or roadless habitat. On the other hand, Middle Main and East Fork PMUs are much more likely to be impacted by both legal and illegal OHV use.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Manage motorized recreation.	Enforce Travel Management Plans.	Provide Law Enforcement Officers (LEO) and Conservation Officers maps and locations of potential conflicts between wild sheep and motorized recreation.	Bighorn Sheep

Objective	Strategy	Recommended Action(s)	Target SGCNs
The Department will work with other land and resource management agencies to ensure that critical areas of habitat are protected from inadvertent disturbance associated with recreational activities such as hiking, OHV use, low-altitude aerial activity, rock climbing, or trail riding (IDFG 2010).	The Department will support investigations into the effects of different types and levels of human activities on Bighorn Sheep (IDFG 2010). In areas where recreation is considered to be a factor limiting the success of a Bighorn Sheep population, IDFG will work with land managers and the public to mitigate the effects of disturbance associated with recreation (IDFG 2010).	Increase BLM and FS LEO patrols and IDFG patrols in areas where Bighorn Sheep are vulnerable to motorized disturbance. Use remote camera technology to monitor potential conflict areas.	
Increase awareness about OHV impacts on Bighorn Sheep.	Provide education to OHV users.	Develop pamphlet outlining potential impacts from motorized disturbance and tips for minimizing disturbance. Post signs at specific roads/trailheads urging users to minimize disturbance.	Bighorn Sheep

Upland nonnative invasive plants

The semi-arid nature of some Bighorn Sheep habitat in all 4 PMUs makes it susceptible to noxious weed invasion, particularly after wildfires or prescribed fires. Cheatgrass, knapweed, and rush skeleton weed could all affect winter range productivity. Middle Fork PMU has been most impacted by wildfire in the past 15 years and some lower elevation, dry sites have been infested with noxious weeds. The Middle Main and East Fork PMUs have had much less wildfire activity, but have higher road densities that allow noxious weeds to gain a foothold. Consequently, most current infestations are limited to road corridors.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Control or eradicate noxious weeds.	Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence (IDFG 2010).	Continue to participate in County Cooperative Weed Management Area collaboratives. Map and identify noxious weed patches and provide to the appropriate land manager. Provide technical assistance and encouragement to land managers for post-fire habitat restoration activities in key wild sheep habitats.	Bighorn Sheep

Objective	Strategy	Recommended Action(s)	Target SGCNs
		Provide native grass and shrub seed recommendations to land managers.	

Altered fire regimes

Natural fire intervals have been altered throughout Bighorn Sheep range in the Challis Volcanics. The Middle Fork PMU has experienced the most natural fire history because it is in remote terrain with little or no human population or structures. The East Fork PMU has some areas, mainly sub-alpine or alpine summer habitat, where natural fire starts are allowed to burn. Lower elevation winter range is nearby ranch and residential structures so any natural fire starts in these areas are subject to aggressive suppression. Similarly, most of the Middle Main PMU is subject to some level of suppression activity. Many years of fire suppression has resulted in lowered productivity of wild sheep range, primarily because of conifer encroachment and subsequent loss of mountain shrub/grassland communities (Dibb and Quinn 2008).

Objective	Strategy	Recommended Action(s)	Target SGCNs
Improve quality and quantity of Bighorn Sheep habitat (IDFG 2010).	Where succession and conifer encroachment have significantly affected Bighorn Sheep habitats, IDFG will work closely with land managers and encourage them to adopt fire and habitat management practices to benefit Bighorn Sheep (IDFG 2010).	Identify and map conifer encroachment on wild sheep winter range where habitat quantity and quality are compromised. Provide technical assistance and encouragement to land managers for habitat improvement projects. Provide native grass and shrub seed recommendations to land managers.	Bighorn Sheep

Target: Bat Assemblage

The Challis Volcanic's vast, natural landscape provides a diversity of suitable habitats for bats. Extensive areas of mixed conifer forest support tree-roosting bats, including Silver-haired and Hoary bats. The section's complex geomorphology gives rise to an abundance of cliffs and rock crevice habitat features available for roosts, maternity colonies, and perhaps hibernacula. The region's long history of mining for silver, lead, copper, and other ores produced a legacy of inactive and abandoned mines creating surrogate cave habitat suitable for winter hibernacula. Knowledge of bats in the Challis Volcanics is incomplete and fragmentary. Information is needed on species distribution, abundance, and habitat

Hoary Bat © 2014 Daniel Neal

associations to effectively develop and implement conservation strategies. What little is known of bats in this section has been gleaned from assessments of abandoned mines on US Forest Service and BLM lands to detect and mitigate public health and safety hazards. In 2015, BLM and IDFG partnered to conduct a landscape-scale bat survey of BLM lands within the Challis Volcanics and Beaverhead Mountains sections to fill some of these data gaps. Survey results will provide preliminary information on distribution, activity centers, and habitat associations of bats in this section, but are also expected to highlight further information needs vital to developing section-specific conservation strategies and actions.

Target Viability

Insufficient data to assess the viability of the bat assemblage in this section.

Prioritized Threats and Strategies for Challis Volcanics Bat Assemblage

Species designation, planning and monitoring

Although relevant information can be extrapolated from other regions to a certain extent, it is essential to understand the conservation status of bats in this section and their vulnerability to both local and pervasive range wide threats. Surveys and monitoring are needed to locate hibernacula, assess local levels of disturbance or destruction of roosting habitats, identify seasonal movement patterns and migration corridors, and assess risks associated with White Nose Syndrome (WNS). Public education on the importance and benefits of bats is needed to counter misconceptions that create challenges for the conservation of bats. Expanded collaboration across jurisdictional boundaries is increasingly important to the persistence of migratory species such as the Silver-haired Bat and Hoary Bat.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Conduct research, inventory, and monitoring to collect basic biological information on bats.	Determine species occurrence, distribution, seasonal patterns, and general habitat associations for bat species in this section.	Conduct targeted surveys to locate key roosting sites such as caves, mines, snags, and bridges to determine species use, seasonal use, and significance to Idaho populations. Participate in the North American Bat Monitoring Program to monitor trends in bat populations at local, state, regional and continental scales. Conduct hibernacula monitoring and surveillance for White Nose Syndrome, adhering to guidance presented in WNS decontamination protocols. Identify potential foraging areas, water resources, and migration corridors and conduct surveys to verify their seasonal use by bats. Refine distribution maps to reflect the most current information, and to identify areas with information gaps to be targeted for surveys. Develop and evaluate new population-	Silver-haired Bat, Hoary Bat, Townsend's Big-eared Bat, Western Small-footed Myotis, Little Brown Bat

Objective	Strategy	Recommended Action(s)	Target SGCNs
		monitoring techniques. Identify potential threats and monitor impacts to populations. Identify and define species-specific population units relevant for conservation planning and research. Identify research projects and pursue needed funding to answer specific questions about bat biology, potential threats, or habitat management strategies. Leverage resources and coordinate efforts among entities conducting bat survey, monitoring, research, and management activities to share data and provide efficiencies.	
Minimize loss and degradation of bat habitat.	Develop management standards and guidelines for bats and include them in new and existing plans that direct habitat and species management activities.	Develop best management practices for bats and provide them to land management agencies, tribes, nonprofit organizations, and private landowners in user-friendly formats that can be distributed on the web or in printed informational pamphlets. Specifically develop best management practices for forest bats including firewood cutting, fuels reduction treatments, salvage logging of burned forests, treatment of insect infestations, commercial timber management, and recreational developments. Identify all important natural and manmade roosts and prioritize for protection the sites that support the largest or most diverse populations and sites that support SGCN. Protect, restore, maintain, and monitor key flight and migratory corridors. Protect, restore, maintain, and monitor open water drinking sites, especially in arid areas. Monitor the effectiveness of management actions implemented for bat conservation, including bat gates, manmade roosts, and other restoration and protection efforts.	
Reverse undue negative social misconceptions of bats that pose a serious impediment to bat conservation.	Establish and quantify the economic and social impacts of bats in Idaho	Conduct research to quantify the economic values of bats in Idaho, with emphasis on consumption of crop, garden, and forest pests. Coordinate with local health officials to develop educational programs regarding verified disease risks associated with bats	
	Develop and distribute	Determine public attitudes and understanding of bats and bat/diseases relationships, to	

Objective	Strategy	Recommended Action(s)	Target SGCNs
	educational materials to key audiences.	determine how best to direct educational efforts. Produce information packets that describe the best management practices for conserving bats, targeted at foresters, ranchers, public health officials, and the public interested in backyard wildlife. Develop and lead bat conservation and education workshops for teachers, biologists, and other specialized groups. Involve the public in citizen science projects such as acoustic monitoring and roost exit counts to help foster bat advocates among the public.	

Target: Pollinators

Pollinators contribute substantially to the food production systems of Idaho, to the economic vitality of the agricultural sector, and to the biodiversity in the ecosystems they inhabit. Pollinators are keystone species in most terrestrial ecosystems, playing a critical role in maintaining natural plant communities and ensuring production of seeds in most flowering plants. Pollinators also comprise a major prey item for many birds and mammals. The viability of pollinator populations has been impacted over recent decades from habitat loss, pesticide use, and introduced diseases. In recognition of widespread pollinator declines, President Obama issued a memorandum in June 2014 directing executive departments and agencies to create a federal strategy to promote the health of pollinators. This memorandum has elevated conservation concern, fostered partnerships, and generated financial resources to promote pollinator conservation across the US.

Little is known about pollinator assemblages in the Challis Volcanics Section. Although there are no Monarch records for this section, showy milkweed (*Asclepias speciosa*) populations have been documented in the Carey and Challis vicinities (Xerces Society 2015), suggesting availability of Monarch breeding habitat. An additional 5 SGCN bee species may occur in this section based on estimated ranges and presence of suitable habitats (Table 6.2). Surveys and monitoring are needed to assess their current status, distribution, and potential threats in this section.

Target Viability

Good. Pollinator viability is presumed to be secure based on large spatial extent and relatively good ecological condition of native plant communities in surrounding public lands. A large segment of agricultural land in the Big Wood, Little Wood, East Fork Salmon, and Round Valley (Challis) drainages consist of hayfields planted to mixes selected for beef-cattle production. Hayfields are often planted to cultivar grasses, legumes (i.e., clovers, alfalfa), and residual native grasses, which attract a diversity of insects and pollinators. Use of glyphosate and neonicotinoid pesticides, implicated in declining bee populations, is typically very low for pasture and hay crops (Thelin and Stone 2013). However, use of these pesticides could increase with conversion of forage lands to more intensively cultivated crops such as wheat, alfalfa, and soybeans.

Monarch nectaring on showy milkweed
© 2014 Beth Waterbury

Prioritized Threats and Strategies for Pollinators

Species designation, planning and monitoring

Gathering baseline data on pollinator populations is essential to assess their current distribution and status, identify potential threats, and develop effective management and conservation actions. As such, we identify needs for 6 species in the table below and identify appropriate actions.

Objective	Strategy	Recommended Action(s)	Target SGCNs
Determine status of target pollinators potentially occurring in the Challis Volcanics Section.	Conduct surveys to detect occurrence of target pollinators.	Conduct pan trap and netting surveys for bees in spring/summer/fall depending on bee species preference for certain genera of plants. Conduct hand net surveys for Monarch adults (May to August) and visual surveys for larvae in June/July/August.	Morrison Bumble Bee, Western Bumble Bee, Suckley Cuckoo Bumble Bee, Hunt's Bumble Bee, A Mason Bee (*Hoplitis producta*), Monarch

Challis Volcanics Section Team

An initial version of the Challis Volcanics Section project plan was completed for the 2005 Idaho State Wildlife Action Plan (formerly Comprehensive Wildlife Conservation Strategy). A small working group developed an initial draft of the Section Plan (Miradi v. 0.12), which was then reviewed by a wider group of partners and stakeholders during a 2-day workshop held at the Idaho Department of Fish and Game Headquarters office, Boise, Idaho in January 2015 (this input was captured in Miradi v. 0.14). Since then, we have continued to work with key internal and external stakeholders to improve upon the plan. Materials in this document are based on Miradi v. 0.##. Individuals, agencies, and organizations involved in this plan are listed in Table 6.3.

Table 6.3 Individuals, agencies, and organizations involved in developing this plan[a]

First name	Last name	Affiliation
Rita	Dixon* [b]	Idaho Department of Fish and Game
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Bret	Stansberry*	Idaho Department of Fish and Game
Jody	Brostrom	US Fish and Wildlife Service
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Bobbi	Filbert	US Forest Service, Sawtooth National Forest
Chris	Murphy	Idaho Department of Fish and Game
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Greg	Painter	Idaho Department of Fish and Game
Gary	Power	Salmon Valley Stewardship, Lemhi Forest Restoration Group, former Idaho Fish and Game Commissioner, retired IDFG Salmon Region Supervisor
Nick	Salafsky	Foundations of Success
Greg	Schoby	Idaho Department of Fish and Game
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Ross	Winton*	Idaho Department of Fish and Game
Bart	Zwetzig	Bureau of Land Management, Challis Field Office

[a] Apologies for any inadvertent omissions.
[b] An asterisk "*" denotes team leader(s) and contact point if you would like to become involved in this work.

Literature Cited

Aubry, K. L., K. S. McKelvey, and J. P. Copeland. 2007. Distribution and broadscale habitat associations of the wolverine in the contiguous United States. Journal of Wildlife Management 71:2147–2158.

Arno, S. F., J. H. Scott, and M. G. Hartwell. 1995. Age-class structure of old growth ponderosa pine/ Douglas-fir stands and its relationship to fire history. Res. Pap. INT-RP-481. Ogden, UT: USDA Forest Service, Intermountain Research Station. 25 p.

Bartos, D. L. 2001. Landscape dynamics of aspen and conifer forests. In: Sheppard, W. D., D. Binkley, D. L. Bartos, T. J. Stohlgren, and L. G. Eskew (Comps.). Sustaining aspen in western landscapes: Symposium proceedings; 13–15 June 2000; Grand Junction, CO. USDA Forest Service Proceedings RMRS-P-18. Rocky Mountain Research Station, Fort Collins, CO: 5–14.

Belnap, J., J. H. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, and D. Eldridge. 2001. Biological soil crusts: ecology and management. U.S.D.I., Bureau of Land Management Technical Reference 1720-2, Denver, CO.

Beschta R. L., J. B. Boone Kauffman, D. S. Dobkin, and L. M. Ellsworth. 2014. Long-term livestock grazing alters aspen age structure in the northwestern Great Basin. Forest Ecology and Management 329, 30–36.

Bock, C. E., V. A. Saab, T. D. Rich, and D. S. Dobkin. 1993. Effects of livestock grazing on neotropical migratory landbirds in western North America. Pages 296-309 *in* D. M. Finch and P. W. Stangel, editors. Status and management of neotropical migratory birds. USDA Forest Service, General Technical Report RM229.

Braun, C. E. 1998. Sage grouse declines in western North America: What are the problems? Proceedings of the Western Association of State Fish and Wildlife Agencies 78:139–156.

Challis Sage-Grouse Local Working Group. 2007. Challis Sage-Grouse conservation plan.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies, Cheyenne, Wyoming.

Copeland, J. P., K. S. McKelvey, K. B. Aubry, A. Landa, J. Persson, R. M. Inman, J. Krebs, E. Lofroth, H. Golden, J. R. Squires, A. Magoun, M. K. Schwartz, J. Wilmot, C. L. Copeland, R. E. Yates, I. Kojola, and R. May. 2010. The bioclimatic envelope of the wolverine (*Gulo gulo*): do climatic constraints limit its geographic distribution? Canadian Journal of Zoology 88:233–246.

Daubenmire, R. 1966. Vegetation: identification of typal communities. Science 151 (3708): 291-298.

DeByle, N. V.; R. P. Winokur, editors. 1985. Aspen: Ecology and management in the western United States. General Technical Report RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 283 p.

Fitch, L., and N. Ambrose. 2003. Riparian Areas: a user's guide to health. Lethbridge, Alberta: Cows and Fish Program. ISBN No. 0-7785-2305-5.

Fitzner, R. E. 1975. Owl mortality on fences and utility lines. Journal of Raptor Research Vol. 9, No. 3/4.

Hicke, J. A., and J. Logan. 2009. Mapping whitebark pine mortality caused by a mountain pine beetle outbreak with high spatial resolution satellite imagery. International Journal of Remote Sensing 30 (17): 4427–4441.

Hoffman, R. L., and D. S. Pilliod. 1999. The ecological effects of fish stocking on amphibian populations in high-mountain wilderness lakes. Final Report. USGS/BRD Forest and Rangeland Ecosystem Science Center. Corvallis, Oregon.

Howard, R. P., and M. L. Wolfe. 1976. Range improvement practices and Ferruginous Hawks. Journal of Range Management 29:3337.

Idaho Department of Fish and Game. 2013. Fisheries management plan 2013–2018. Idaho Department of Fish and Game, Boise, USA.

Idaho Department of Fish and Game. 2014. Management plan for the conservation of wolverines in Idaho. Idaho Department of Fish and Game, Boise, USA.

Idaho Sage-grouse Advisory Committee. 2006. Conservation Plan for the Greater Sage-grouse in Idaho.

Jankovsky-Jones, M. 1997. Conservation strategy for Big Wood River Basin wetlands. Idaho Department of Fish and Game, Boise, USA.
https://fishandgame.idaho.gov/ifwis/idnhp/cdc_pdf/bwplan.pdf

Johnson, C. G., and D. K. Swanson. 2005. Bunchgrass Communities of the Blue and Ochoco Mountains: A Guide for Managers. U.S.D.A. Forest Service PNW-GTR-641.

Keane, R. E., D. F. Tomback, C. A. Aubry, A. D. Bower, E. M. Campbell, C. L. Cripps, M. B. Jenkins, M. F. Mahalovich, M. Manning, S. T. McKinney, M. P. Murray, D. L. Perkins, D. P. Reinhart, C. Ryan, A. W. Schoettle, and C. M. Smith. 2012. A range-wide restoration strategy for whitebark pine (*Pinus albicaulis*). Gen. Tech. Rep. RMRS-GTR-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 108 p.

Kulakowski D., M. W. Kaye, D. M. Kashian. 2013. Long-term aspen cover change in the western US. Forest Ecology and Management 299, 52-59.

Littell, J. S., D. McKenzie, D. L. Peterson, and A. L. Westerling. 2009. Climate and wildfire area burned in western U.S. ecoprovinces, 1916-2003. Ecological Applications. 19(4): 1003-1021. doi:10.1890/07-1183.1

Maestas, J. D., and S. B. Campbell. 2014. Mapping potential ecosystem resilience and resistance across sage-grouse range using soil temperature and moisture regimes. Fact sheet. Sage Grouse Initiative, www.sagegrouseinitiative.com.

Maret, T. R., J. E. Hortness, and D. S. Ott. 2006. Instream flow characterization of upper Salmon River Basin streams, central Idaho, 2005: U.S. Geological Survey Scientific Investigations Report 2006-5230, 110 p.

Morelli, T. L., and S. C. Carr. 2011. A review of the potential effects of climate change on quaking aspen (Populus tremuloides) in the Western United States and a new tool for surveying sudden aspen decline. Gen. Tech. Rep. PSW-GTR-235. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 31 p.

Pilliod, D. S., and C. R. Peterson. 2001. Local and landscape effects of introduced trout on amphibians in historically fishless watersheds. Ecosystems 4:322-333.

Pilliod, D. S., D. Duncan, C. R. Peterson, and J. J. Yeo. 1996. Spatial distribution and habitat associations of amphibians in the Bighorn Crags, Frank Church River of No Return Wilderness. 1994 Final Report to USDA Forest Service, Intermountain Research Station, Boise, Idaho.

Rehfeldt, G. E., D. E. Ferguson, and N. L. Crookston. 2009. Aspen, climate, and sudden decline in western USA. Forest Ecology and Management 258, 2353–2364.

Rich, T. D., M. J. Wisdom, V. A. Saab. 2005. Conservation of sagebrush steppe birds in the interior Columbia Basin. General Technical Report PSW-GTR-191. In: Ralph, C.J., Rich, T., Long, L. (Eds.), Proceedings of the Third International Partners in Flight Conference, U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, CA, pp. 589-606.

Rieman, B. E., and D. J. Isaak. 2010. Climate change, aquatic ecosystems, and fishes in the Rocky Mountain West: implications and alternatives for management. Gen. Tech. Rep. RMRS-GTR-250. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 46 p.

Saab, V. A., and T. Rich. 1997. Large-scale conservation assessment for neotropical migratory landbirds in the Interior Columbia River Basin. USDA Forest Service General Technical Report PNW-GTR-399. Saab, V. A., C. E. Bock, T. D. Rich, and D. S. Dobkin. 1995. Livestock grazing effects in western North America. in T.E. Martin and D. M. Finch, editors. Ecology and management of Neotropical migratory birds. Oxford University Press, New York, New York, USA.

Schwartz, M. K., J. P. Copeland, N. J. Anderson, J. R. Squires, R. M. Inman, K. S. McKelvey, K. L. Pilgrim, L. P. Waits, S. A. Cushman. 2009. Wolverine gene flow across a narrow climatic niche. Ecology 90:3222–3232.

Smith B. L., J. S. Dieni, R. L. Rogers, and S. H. Anderson. 2001. Effects of Ungulate Browsing on Aspen Regeneration in Northwestern Wyoming. In: Shepperd, W. D.; Binkley, D.; Bartos, D.L.; Stohlgren, T.J.; and Eskew, L.G., compilers. 2001. Sustaining aspen in western landscapes: Symposium Proceedings; 13-15 June 2000; Grand Junction, CO. Proceedings RMRS-P-18. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 460 p.

Stephens, S. L., J. D. McIver, R. E. J. Boerner, C. J. Fettig, J. B. Fontaine, B. R. Hartsough, P. I. Kennedy, and D. W. Schwilk. 2012. The effects of forest fuel-reduction treatments in the United States. BioScience. 62(6): 549-560. doi:10.1525/bio.2012.62.6.6

Stevens, B. S., K. P. Reese, J. W. Connelly, and D. D. Musil. 2012. Greater sage-grouse and fences: Does marking reduce collisions? Wildlife Society Bulletin 36(2):297-303.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward earlier streamflow timing across western North America. Journal of Climate. 18: 1136-1155.

van Mantgem, P. J., N. L. Stephenson, J. C. Byrne, L. D. Daniels, J. F. Franklin, P. Z. Fulé, M. E. Harmon, A. J. Larson, J. M. Smith, A. H. Taylor, and T. T. Veblen. 2009. Widespread increase of tree mortality rates in the western United States. Science. 323(5913): 521-524.

Tesky, J. L. 1993. Ovis canadensis. In: Fire effects information system. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available: http://www.fs.fed.us/database/feis/ [2015, November 3].

Thelin, G. P., and W. W. Stone. 2013. Estimation of annual agricultural pesticide use for counties of the conterminous United States, 1992–2009: U.S. Geological Survey Scientific Investigations Report 2013-5009, 54 p.

Upper Snake Sage-Grouse Local Working Group. 2009. Plan for increasing Sage-Grouse populations.

USDI-Fish and Wildlife Service. 2005. Endangered and Threatened Wildlife and Plants: 12-Month Finding for Petitions to List the Greater Sage-Grouse as Threatened or Endangered. Federal Register 70:5. 2244-2282.

West, N. E., and J. Gasto. 1978. Phenology of the aerial portions of shadscale and winterfat in Curlew Valley, Utah. Journal of Range Management 31:1.